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WHAT PRICE PROFESSIONAL PROGRESS?

CHEMISTS AND ENGINEERS are beginning to pay dearly for their lack of accepted professional status. In Washington in spite of protest, codes are being written which penalize the progress of scientific research. Salary scales for technical men, forced by the depression to ridiculously low levels, are not keeping pace with the recovery movement. Unfortunately, the chemical organizations are only now beginning to awaken to the pressing need for professional development.

At the St. Petersburg meeting of the American Chemical Society a strong committee of the council was empowered to protest against the inclusion of research as a subsidiary activity of the "commercial testing laboratory industry." The very fact that scientific research should be given such a classification is an indictment against the chemical profession. Had we attained and insisted upon the same professional status as doctors and lawyers, there would have been no such obstacles placed in the way of our creative work. It may be argued, of course, that the NRA codes affect only the clerks and laboratory assistants receiving less than $35 per week—yet again it is unfortunately true that important detailed work is in the hands of just such poorly paid assistants.

Consider an instance reported in Newark (N. J.) *Sunday Call* of March 5. That thriving chemical metropolis sought four employees —a painter, a chauffeur, a teacher for the City Home and an assistant chemist for the Health Department. The painter and chauffeur, with grammar school education or its equivalent, were offered base salaries of $2,820 and $1,620, respectively. The teacher, who must be a normal school graduate, was to be paid $300 less than the chauffeur. The chemist, who must be a college or university graduate with two years' experience in analytical chemistry, was to receive the handsome salary of $1,200 a year, less deductions. Such is the price of chemical education and experience in one of the great centers of chemical industry in America!

Who is responsible for this sorry situation? To a large extent the chemist himself is to blame for failing to demand an adequate return on his own investment. To a large extent our scientific and professional societies are also responsible. They have been so occupied with advancing the science through publications and research, that they have sadly neglected their human responsibilities. Furthermore, through high school essay contests, sensational newspaper publicity and similar propaganda, they have attracted into chemistry hundreds, if not thousands, of young men who might better have been painters or chauffeurs or brick layers.

What's to be done about it? In our opinion the single most important problem before our societies today is to enhance the professional status of the chemist and the chemical engineer. The latter has already made something of a start on a national scale through the Engineers' Council for Professional Development, discussed by Dr. Parmelee in the January issue of *Chem. & Met.* An interesting local experiment (described elsewhere in this issue) is being started by a chemical engineering group at Neenah, Wisconsin. Of necessity, progress is likely to be slow and painful, but in the long run of much more importance to the chemical profession than present empty honors and emptier pocketbooks.

EDITORIALS

What Is the Meaning Of Cheap Power?

MUCH is being heard these days of cheap power. Chemical industry should consider what it means. It should take into account how cheap the power may become, and what to do with it when it is here.

Federal influence in hydroelectric development is today making itself felt through the erection of a number of large water-power plants. T.V.A. is but one evidence of this. The immediate result will be a flood of available new power near each important project, power which will be produced at prospectively low cost, and in some instances sold at rates lower than anything hitherto offered in most parts of the country.

Process industries which generally are large consumers of power will, therefore, be greatly affected as these developments are realized. It may yet be too early to say just how cheap the power will be. Still, it is not altogether too soon to do some calculation and revision on the basis of assumed figures. New industrial centers are bound to grow up around most of these power projects. Some of these may become electrochemical centers rivaling even Niagara Falls in size and importance. And it is up to every manufacturer to determine whether or not his interests should be represented in these new groups.

This may even be the time for management to get out ideas formerly abandoned and recalculate them on the new basis. Dust off discarded processes and find out if new locations with a supply of cheap power may not have changed the picture. Out of such studies fruitful ideas may come forth.

New Factors in Choice of Fuel

FUEL AND ENERGY supplies for the process industries are always important. Usually there is a choice between coal, oil, and gas, often between one of these fuels and electrical energy supply. The basis for choice to secure minimum cost is rapidly becoming more complicated, and may even result in the need for important changes in management policy.

N.R.A. code provisions are, of course, raising costs of coal at the mine while the Petroleum Administration's action curtails raw petroleum supply, with prospect of continued advance in the costs of liquid fuel. As a sort of equalization or compensatory tax, the solid and liquid fuel industries now ask that some burden be put on natural gas.

Some of these factors appear to be comforting to the manufactured gas industry. But that industry has lately experienced such severe competition in its effort to reach major industrial groups that price levels for coal and oil can advance significantly without doing more than restore relations normal a few years ago.

No one can safely forecast quantitatively the magnitude of these changes. All that is necessary at the moment is a word of caution against too radical new commitments in choice of energy without assurance as to price levels beyond the current year. Chemical engineers who must at this time calculate on future costs of energy will do well to take account of these rising price trends, all of which are quite independent of the general program of inflation.

Meeting the Tax On Vegetable Oils

USERS of vegetable oils for purposes other than food manufacture are apparently doomed to shoulder some additional tax burden. Congress insists on calling the new levy an excise tax, but it is in fact a thinly disguised tariff. However, the name is of little importance. The financial burden is the major factor.

To meet the new problem technical as well as managerial skill will be required. The ideal solution, particularly for the soap industry, would be to offset the burden by improved technology. Certain vegetable oils are not as suitable in the manufacture of soap as others. The soap manufacturer comes to this conclusion largely from empirical observations, as he is only able to prove it in part on the basis of the ratio of fatty acids contained. One may, therefore, put two questions.

First, we inquire, is there not a new technique of soap making, modified formulas, new proportioning of domestic oils, that may offset the disadvantages of those raw materials available in abundance? Secondly, could not methods be devised whereby the chemical characteristics of other oils might actually be so modified that they might be used in the process on equal basis with those preferred imported oils used in the past? Much fundamental thinking and research will be needed. The problems involved are of sufficient importance to merit generous research expenditures and thoughtful interpretation of results.

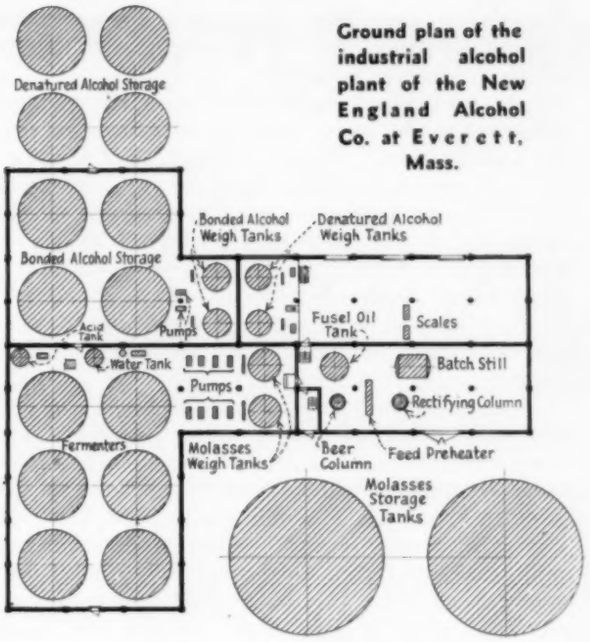
The new tax is more than a threat. It is a technologic challenge to the users of vegetable oils.

A Chemical Engineer Becomes a College President

LAST SPRING the organic chemists had their day in court when one of the best loved of their number was selected for the presidency of our oldest American university. But Dr. James B. Conant was not the first chemist to serve in that capacity for a distinguished predecessor at Harvard was President Charles William Eliott and Ira Remsen, Edgar Fahs Smith, Charles Venable were first chemists and later college presidents. We hazard the guess, however, that the first to have received formal training in chemical engineering is Arthur Cutts Willard who on March 14 was elected president of the University of Illinois. Although Professor Willard had been most noted for his work in heating and ventilating and had served with distinction as dean and head of mechanical engineering, his bachelor's degree was in chemical engineering from the Massachusetts Institute of Technology in 1904. Hence we believe we may claim him, despite his excursions into related fields, as chemical engineering's first university president.

By R. R. COLLINS
Vice-President, The Lummus Co., New York, N. Y.

Continuity of Operation A Feature of Modern Alcohol Distillery



Ground plan of the industrial alcohol plant of the New England Alcohol Co. at Everett, Mass.

THE RECENTLY COMPLETED industrial alcohol plant for the New England Alcohol Co. at Everett, Mass., is an interesting example of a modern plant for the production of ethyl alcohol by the fermentation of black strap molasses. The plant as initially installed has capacity for producing 3,000,000 gal. of 95 per cent alcohol per annum. Special consideration has been given to the economics of production, yield and quality of products, ease of operation and provision for future expansion of the plant capacity.

While the manufacturing process follows the conventional steps of molasses dilution, fermentation, distillation and denaturing, the plant provides refinements in arrangement and special equipment developed by the Lummus Co. during long experience in this field. The principle of centralized control is utilized to an extent which makes it possible for an operator stationed at the control gallery to observe and regulate the performance of practically the entire plant. This perfection of control, coupled with the fact that even such operations as molasses mixing have been made continuous, enables the plant to function with the smoothness and economy of labor obtained only through continuity of operation.

In so far as it is possible the entire plant operation is on a continuous basis. Pure yeast is prepared in closed fermenters. All fermenter gases are scrubbed with water for recovery of alcohol. The molasses used for yeasting is sterilized, but the molasses entering the mash of the main fermenter is acidified in place of being sterilized. A Magne pure yeast culture is employed for the fermentation. This pure yeast is continuously propagated from a culture seeding in two special machines and is acclimatized to resist a relatively high degree of acidity. The diluted molasses entering the main fermenters is continuously acidified by the addition of sulphuric acid in quantities sufficient to suppress the activity of wild yeasts which may be present in the molasses. The quantity of sulphuric acid added may be as high as 1.5 parts per 100 parts of mash, but the pure yeast culture employed for fermentation will perfectly resist this degree of acidity without loss of activity, and produce a high yield of alcohol from the unsterilized molasses.

Molasses is pumped from storage tanks to two weighing tanks arranged in duplicate so that one tank can be filled from storage while the other is discharging to the mixer. Molasses from the weight tanks is pumped continuously to one end of the Lummus mixer, while fresh water from the scrubber surge tank is pumped continuously to the other end of the mixer. The latter is a patented counter-current contact device in which molasses and water meet in opposing streams of high-velocity producing a continuous flow of diluted molasses. A tester adjacent to the mixer provides a hydrometer spindle giving a continuous reading of specific gravity of the wort. The mixing system requires little attention following the original adjustment.

The wort flows continuously to the acidifier, which is a cascading device producing an intimate mixture between the continuously flowing stream of wort and a small quantity of sulphuric acid which is admitted continuously from the acid feed tank.

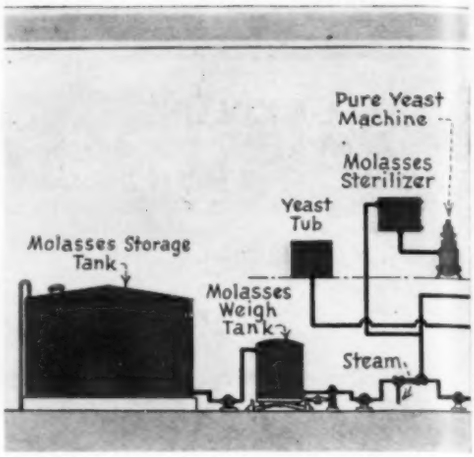
Dilute molasses which is used for yeasting is delivered to the sterilizer. This device is provided with steam coils for heating the wort to sterilization temperature,

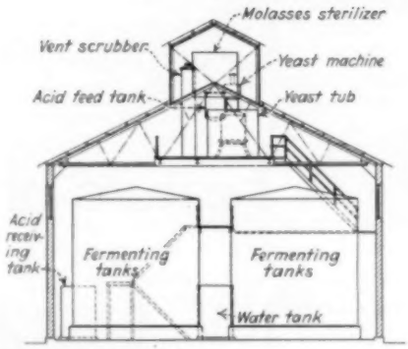
and with air and steam spargers. The sterile wort from the sterilizer flows by gravity to the pure yeast machines and to the yeast tubs.

In the pure yeast machines, a pure culture yeast is propagated in the sterile wort under controlled temperature and air supply. From the batch of pure yeast thus developed portions are withdrawn every 12 hr. for inoculation of larger batches of wort in the yeast tubs, compressed air being used to transfer from the yeast machine to the tubs.

Conversion of the sugars in the wort is accomplished by the use of pure yeast cultures withdrawn as required from the pure yeast machine. This vessel is originally seeded with a strain specially selected for fermentation of cane molasses and acclimatized for use in slightly acid wort. Once charged to the pure yeast machine the "mother" yeast can be depended upon to reproduce successive generations without loss of efficiency or degeneration of the strain. Acidification of the wort retards the growth of wild ferments which produce undesirable products such as butyric acid and tends to limit the production of alcohol. Use of a virile acid-resisting pure yeast strain makes it possible to overcome wild ferments.

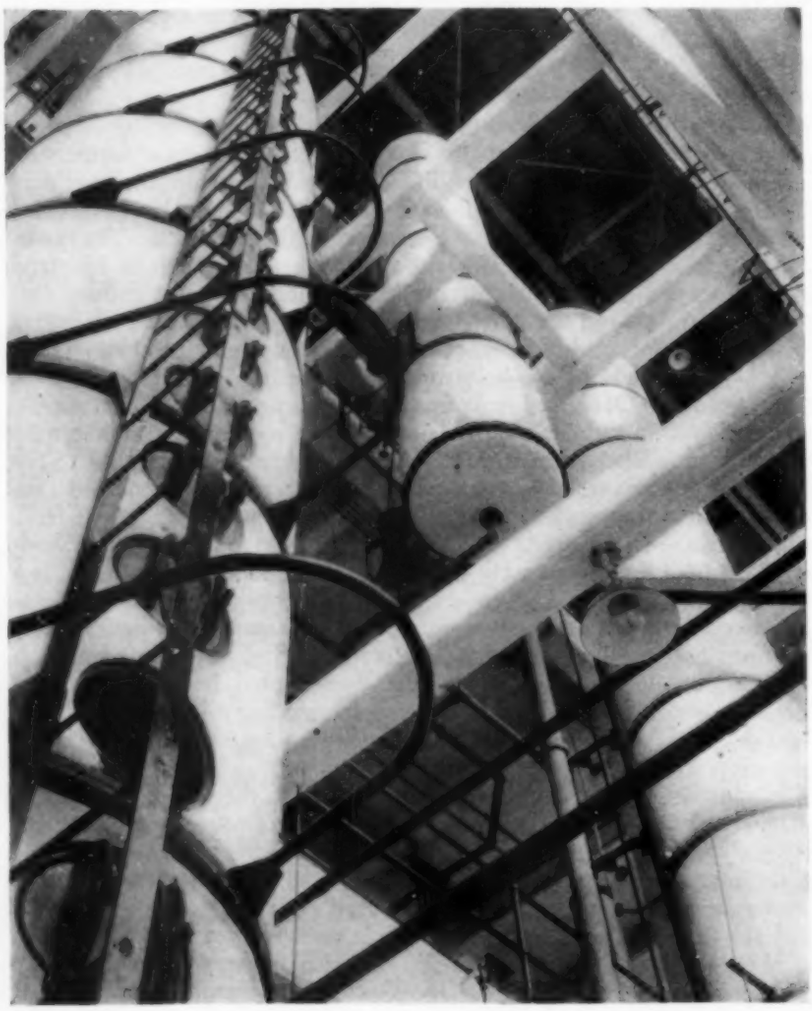
The use of a pure yeast machine which grows the daily requirements of yeast under ideal conditions represents modern practice as contrasted to the older method in which a pure yeast culture is used for inoculating an initial batch of wort in a tub.





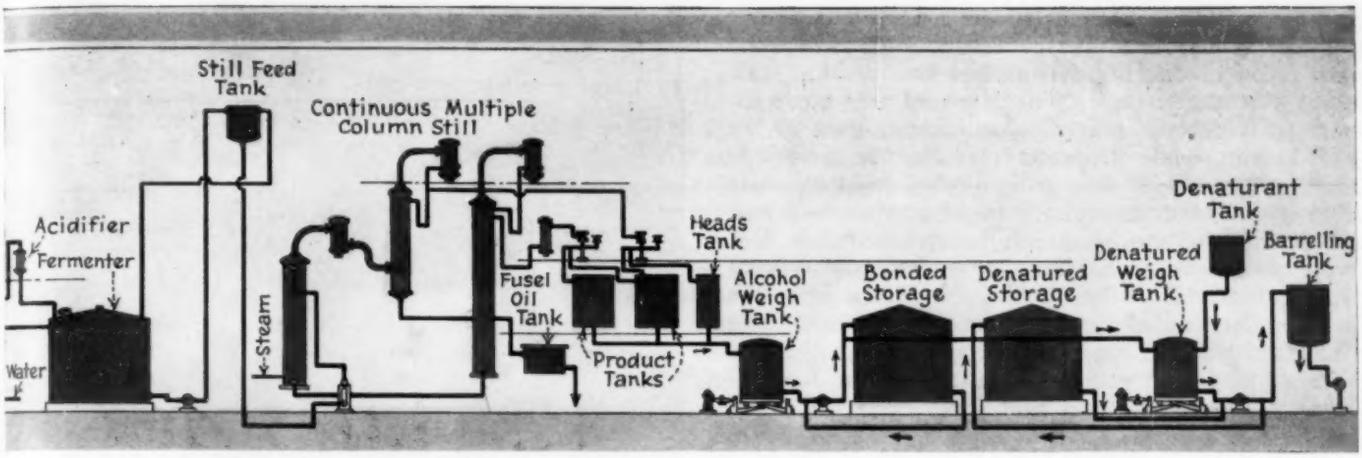
Elevation of the fermenting room showing yeast equipment

Continuous multiple column still producing 8,000 gal. per day of 95 per cent alcohol



Three yeast tubs are provided, each having a capacity for seeding one fermenter every 12 hr., two batches being required per day. One tub is therefore a spare providing time for filling and cleaning. The tubs are used alternately so that a batch of yeast may be prepared in one while the other is discharging previously prepared yeast to the fermenting vats.

The yeast from the tubs flows by gravity, continuously to the fermenters, where it is mixed with the stream of acidified wort from the wort acidifier previously described. The yeast and wort flow continuously into each of the fermenters in turn at a uniform rate sufficient to charge one fermenter each 12 hr. Six fermenters provide for the progressive steps of charging, fermenting, emptying and cleaning, in order. Two fermenters are charged per day, the charging period for each is twelve hours, the wort and yeast being introduced simultaneously, fermentation starts at once, and has progressed



Arrangement of equipment in a modern plant for the production of ethyl alcohol by the fermentation of black strap molasses

for an average of 6 hr. by the time the fermenter is filled. Allowance is made for an additional fermentation period of 44 hr. making a total fermenting period of 50 hr. The emptying period is 12 hr. and 4 hr. are allowed for cleaning. The complete cycle for each fermenter is 72 hr.

Fermenters are closed type, constructed of ingot iron with vent connections for carrying off the carbon dioxide gas formed during fermentation. This gas passes to the vent scrubber where it passes upward in counter-current fashion with a downward flowing stream of water over contact baffles. Any alcohol vapor contained in the carbon dioxide gas is thereby dissolved in the water and carried to the water tank. As previously described, this water is used for continuously diluting molasses. Alcohol thus recovered is therefore conducted to fermenters and is returned to the mash.

The fermented mash is pumped continuously from each of the finished fermenters in turn, at a uniform rate, and is delivered by the still feed pumps to the elevated still feed tank. The rate of feed is controlled by a liquid-level control.

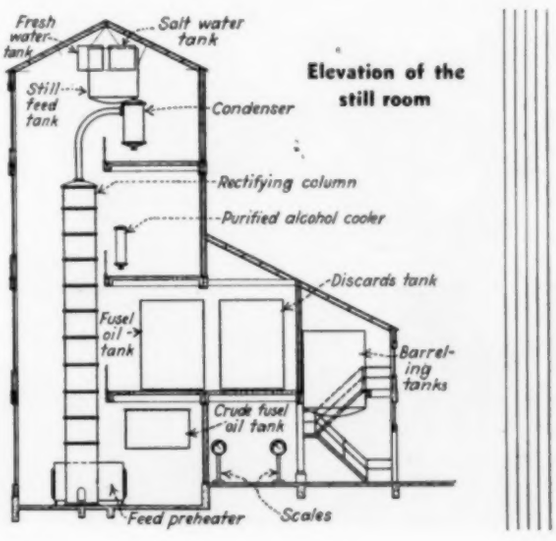
Special provision has been made throughout the fermenting and yeasting system for elimination of wild bacteria. All vessels and piping are arranged for sterilizing and for cleaning with antiseptics. The air entering the yeasting equipment is passed through antiseptic solutions. Pockets in piping, which are a fruitful source of contamination, have been carefully avoided.

It may truly be said that the overall performance of an alcohol plant is determined more by the distillation equipment than any other factor. No matter how complete the conversion of sugar to alcohol, no matter how limited the growth of wild ferments, the final purity of alcohol depends upon the efficiency with which the still may be operated. Although the still does nothing more than extract and purify the alcohol which the fermentation produces, failure to perform this duty will limit the yield and quality of output of the whole plant. Of special importance is the efficiency with which the aldehydic heads products and fusel oils may be separated from the pure alcohol.

The mash flows continuously by gravity from the still feed tank through feed gage to feed heater. The gage provides means for observing and regulating the rate of flow of feed to the still. The feed is heated in the heater by means of the hot waste slop continuously discharged from the bottom chambers of the beer column and the rectifying column. The slop after giving up a large part of its heat to the feed liquor is discharged to waste.

The still is of the continuous type comprising three connected columns together with condensers, coolers, controls and accessory equipment. The still produces 95-96 per cent alcohol direct from the fermenter mash and continuously separates the heads (low boiling) impurities and fusel oils (high boiling) impurities. Each column is provided with a separate steam supply, regulated by an automatic pressure regulator which is actuated by a change of pressure in the column. The discharge of effluent liquor from each column is controlled by an automatic liquid-level control located outside of the column. Two vapor testers are provided for continuously condensing small samples of vapor from the base chambers of the beer column and the rectifying column in order to detect the presence of alcohol in the effluent liquor. A tester is provided for sampling the vapors entering the heads separating column. The condensed vapors thus sampled are returned to the still.

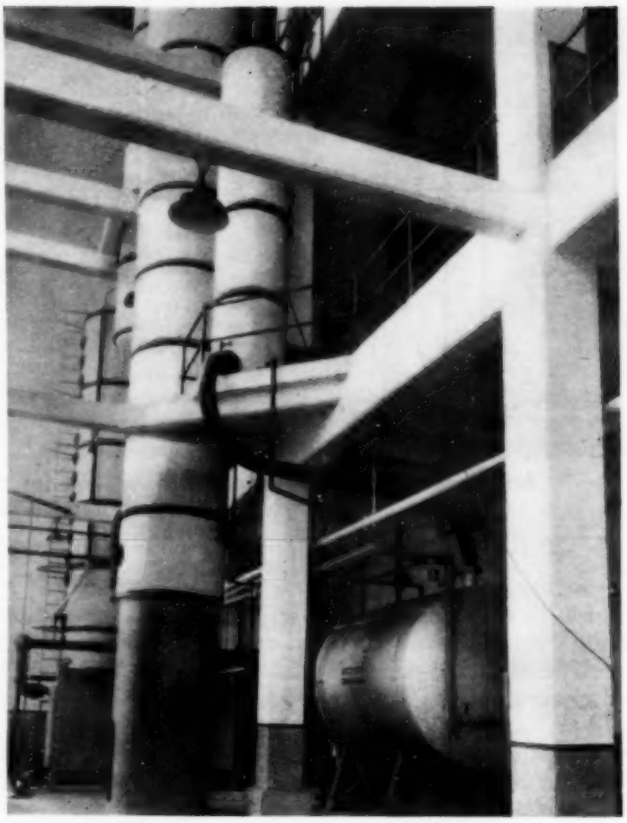
Function of the beer column and its reflux condenser



are to separate and concentrate the 5 per cent to 8 per cent alcohol contained in the feed liquor (fermented mash), and to discharge an alcohol-free residue from the base of the column. The overhead vapors of approximately 50 per cent alcohol content, pass to the heads column while the watery residue of the feed is discharged as "slop" free from alcohol from the base of the beer column through the feed heater to the sewer. The function of the heads column and its reflux condenser and cooler condenser is to separate and concentrate the "heads" or low boiling impurities from the partially concentrated alcohol. The overhead condensate is conducted to the heads alcohol gage where the rate of flow, temperature and concentration can be continuously observed. The effluent liquor from the base of the heads column flows to the rectifying column.

The function of the rectifying column is threefold—to separate last traces of low boiling impurities which are condensed and cooled by the condenser and returned to the heads column; to separate high boiling impurities classed as fusel oil; and finally to concentrate the finished alcohol to 95-96 per cent which is withdrawn continuously from the upper plates of the column through a cooler to the purified alcohol gage.

High-boiling impurities (crude fusel oils) are withdrawn at the point of maximum concentration in the intermediate part of the column and pass as a continuous feed to an auxiliary column which has a total condenser. The base of the column is heated with vapors from the base chamber of column in regulated quantity sufficient to distill the feed. The function of column is to strip off the alcohol contained in the feed, which alcohol is condensed and returned to the beer column. The concentrated fusel oil is withdrawn from the upper plates of the auxiliary column and is cooled in a small condenser which is provided with a gage. The effluent is discharged from the auxiliary fusel oils column to the base chamber of the rectifying column as shown.



On left is a batch still and on the right is the still kettle

A batch still with rectifying column, reflux condenser and cooler condenser is provided for rectifying crude fusel oils which are accumulated in the crude fusel oil tank, and for occasional recovery of alcohol from discards which are accumulated in a discards tank. These tanks are provided with a direct pipe connection to the still permitting the latter to be charged by gravity flow.

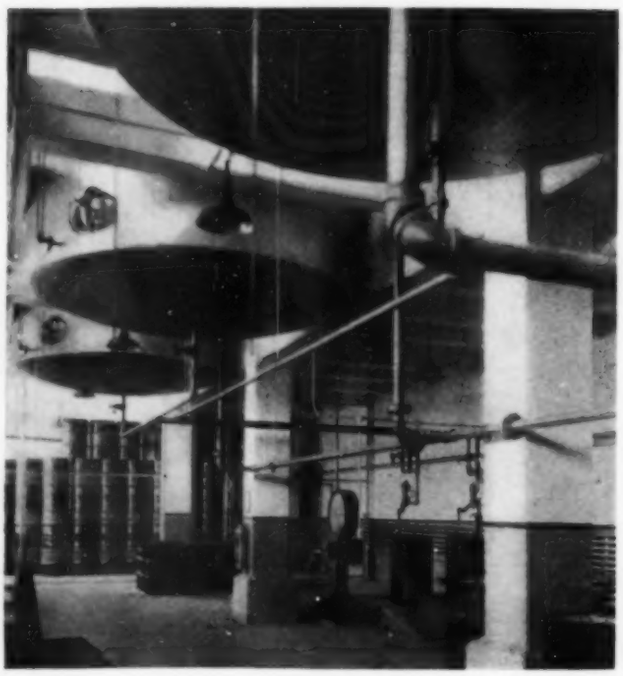
Purified alcohol from the purified alcohol gage flows to the purified alcohol tank. Two tanks are provided each with capacity for a full day's run. Duplicate tanks permit withdrawal from one while the other is filling, thus providing accurate accounting of the daily production.

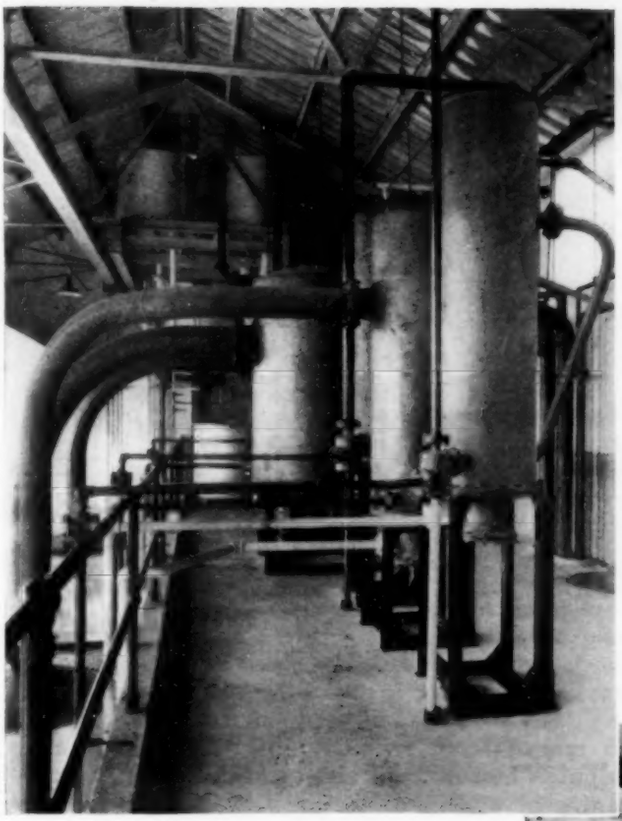
The heads alcohol from heads alcohol gage flows to the heads alcohol tanks. Two tanks are provided, one of which accumulates the day's run, while the other is discharge to storage.

All of the tanks mentioned are provided with locked valves on all inlet and outlet connections so that liquids cannot be admitted or withdrawn except in the presence of the Internal Revenue officer. The tanks are elevated above the floor and are provided with a pneumercator system of calibration, by which the contents of the tanks are indicated on a direct reading scale on the operating platform.

The entire operation of the distilling unit is controlled from the operating platform at the third-floor level. At this point are centralized all of the product gages, instruments, steam and water controls, so that the operator has the distillation under constant supervision and control without leaving this point.

Barrelling tanks and scale. A beam of light from "electric eye" is intercepted by pointer on scale when barrel is full shutting valve





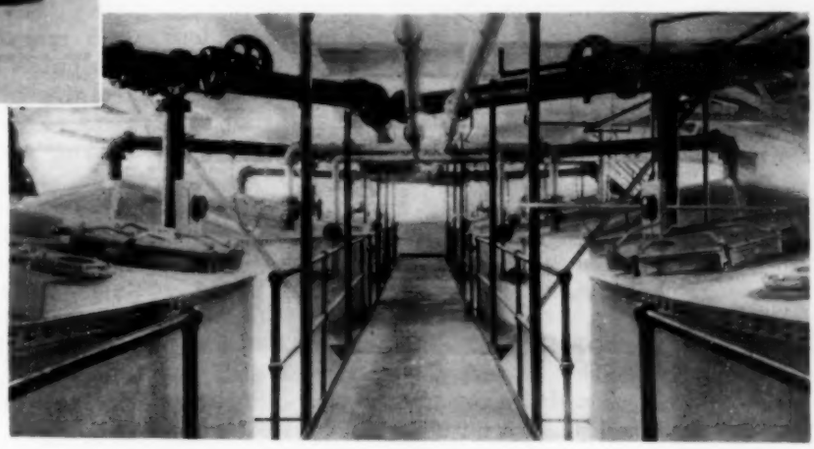
Condensers for the continuous stills. Nearer the roof are located the water head tanks

by which the mixing may be accomplished by recirculation of the contents.

Twelve denaturant storage tanks are provided, and located at a level above the weigh tank. These tanks are filled by transfer of liquid by the denatured alcohol pumps from a connection to tank cars or drums. Each tank is provided with gage glasses of the self closing type. The outlet from each tank is carried by gravity flow to a measuring tank which is accurately calibrated for determination of the quantity of denaturant materials to be added to each charge to the denaturing weigh tanks. The denaturants flow by gravity to the weigh tanks. Distilled water required for reducing strength may be added in the same manner.

Alcohol denatured in accordance with completely denatured formulas is transferred from the weigh tank by means of the pumps to the completely denatured storage tanks. Four tanks are provided, each of 75,000 gal. capacity. A pneumercator system provides measurement of the liquid contents and replaces the usual gage glass.

Completely denatured or specially denatured alcohol to be placed in drums passes through the barrelling tanks.



Two rows of fermenters in the Everett plant of the New England Alcohol Co.

Due to the arrangement of the distilling equipment in an open well running from floor to roof, the operator also obtains to an unusual degree, a visual control over the entire still building and is in position to instantly detect by sight or hearing any departure from routine operation.

Separate pipe lines from the purified alcohol receivers and from the heads alcohol receivers, convey the alcohol by gravity flow to the bonded alcohol weigh tanks.

Four bonded alcohol storage tanks are provided, each having capacity of 75,000 gal. A pneumercator system with a direct calibrated gage located at the bonded weigh tanks gives the liquid content of each tank and replaces the usual gage glasses.

Alcohol required for denaturing, complete or special, is withdrawn from bonded storage tanks under supervision of the Internal Revenue officer and transferred by the bonded alcohol pumps to the denaturing weigh tanks. Two weigh tanks are provided each of 6,000 gal. full capacity, mounted on scales. Each tank is provided with an air sparger for agitation and mixing of the contents and is also connected to a denatured alcohol pump

Three tanks, each of 7,000 gal. capacity, are elevated above the shipping room floor for gravity flow to the drums to be filled. These tanks may be filled by transferring completely denatured alcohol from storage tanks or by the pumps transferring either specially or completely denatured alcohol from the weigh tanks.

The discharge from the barrelling tanks is to a header mounted over the barrelling scales. The filling lines are controlled by a solenoid valve, actuated by an electric eye on the scale. Alcohol to be barrelled in bond for shipment under government supervision as undenatured spirit is filled into drums directly from the bonded alcohol weigh tanks located in the bonded warehouse.

The plant is arranged in the form of a Tee. The fermenting and alcohol storage tanks are located in the head of the Tee, while the distillation and denaturing and shipping occupy the stem.

Unusual speed was made in constructing the plant. Twenty weeks after ground was broken the plant was in operation. This record was made despite the fact that to gain solid foundation it was necessary to drive about 800 40-ft. piles.

CHEMICAL INDUSTRY'S

In spite of the admitted failure of attaining all objectives the first five-year plan wrought some of the most stupendous changes ever observed in the economic and industrial life of a nation. With the proverbial first difficulties out of the way the chances for a more perfect realization of the aims of the second plan appear much brighter. Some of the achievements, and a few of the new objectives in the chemical field are presented here. The data are in part from a report by V. M. Molotov and V. V. Kuibyshev, chairman of the Council of People's Commissars and chairman of the State Planning Commission, respectively, in part from Alcan Hirsch's new book, "Industrialized Russia."—EDITOR.

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THE ESTABLISHMENT of diplomatic relations between the United States and the Soviet Union, the completion of the first five-year plan, and the launching of a second plan of a similar nature are among the interesting features in the present Russian situation. Although most of the objectives of the first plan were only realized in part, the foundation was laid for a modern industrial structure, with the resulting complete reconstruction of the national economy of a state, or rather a group of states, formerly predominantly agricultural in aspects and on a plane of development over 100 yr. behind that of the western world. Many entirely new branches of industry were established, an extensive utilization of the numerous domestic resources was launched, and the difficult undertaking of educating millions of peasants to the more complex tasks of an industrialized civilization made definite progress.

During the first five-year plan the interest in American technique lay mainly in the utilization of American equipment in the construction of new plants and in the establishment of branches of industry organized for the first time in the Soviet Union. The greatest interest at the present moment lies in the extensive experience of American industry in the greatest possible utilization of capital investment, the rationalization of production, and the ability to operate at low cost and to manufacture goods of high quality.

During the first five-year plan the chemical industries ranked third in capital investment. The backward position of this industry prior to the World War is clearly seen from the fact that the per capita production of sulphuric acid was less than a twentieth of that of the western industrial nations. An adequate domestic production of this basic commodity was a necessary first step in the establishment of a chemical industry.

Formerly all pyrite used in sulphuric acid manufacture was imported; now domestic deposits in the Ural are being utilized, in addition to metallurgical byproducts such as flotation tailings and smelter gas. A new deposit of sulphur has also been discovered recently in Central Asia. As a result the production of sulphuric acid reached about 500,000 metric tons in 1932; at present it is almost twice that figure.

In a country with agricultural interests as far-reaching as that of the Soviet Union the manufacture of fertilizers must necessarily play a dominant part. Consumption of this commodity prior to the War was practically nil, only about 60,000 tons annually confined to a small tonnage of superphosphate produced from imported phosphates. In 1932 the corresponding figure was slightly above 600,000 tons, and today's production is at a rate of about 1,000,000 tons. Several important phosphate deposits have also been discovered, most interesting of which are the huge Khibini deposits on the Kola peninsula. Adverse climatic conditions made the opening of these remote deposits an extremely difficult undertaking. Nevertheless, a concentration plant with an annual capacity of 250,000 tons of apatite concentrates, built by General Engineering Co., was put into operation in 1932, while a unit three times as large is under construction at the present time. An interesting feature is that the apatite is associated with nepheline, an alkali-aluminum silicate. Separation of the two minerals is effected by flotation. The nepheline itself is finding many uses in the chemical industry, in the production of aluminum oxide, glass, and ceramics, for tanning leather, and for soil preparation.

Great Chemical Centers

Among the several potash deposits discovered during the last few years none exceed in magnitude those at Solikamsk, near which has been built the important Berezniki chemical center, consisting of 10 plants. Production from this deposit alone reached 300,000 tons in 1932, ranging from 15 to 60 per cent K_2O. When the present development in this field has been completed the annual output will be about 3,000,000 tons.

In addition to Berezniki-Solikamsk four other important chemical centers are under construction, one at Bobriki, near Moscow; one near Leningrad; one in the Ukraine district, and one in Central Asia. Acids and fertilizers are the chief products of all these. The present annual capacity of fixed nitrogen is in excess of 75,000 tons, produced with modern equipment, most of which is of American design. Nitrogen Engineering Corp. and E. I. duPont de Nemours are responsible for much of the development in this field.

A great variety of other chemicals is also produced in addition to the major products. Large chemical plants

ADVANCE IN SOVIET UNION

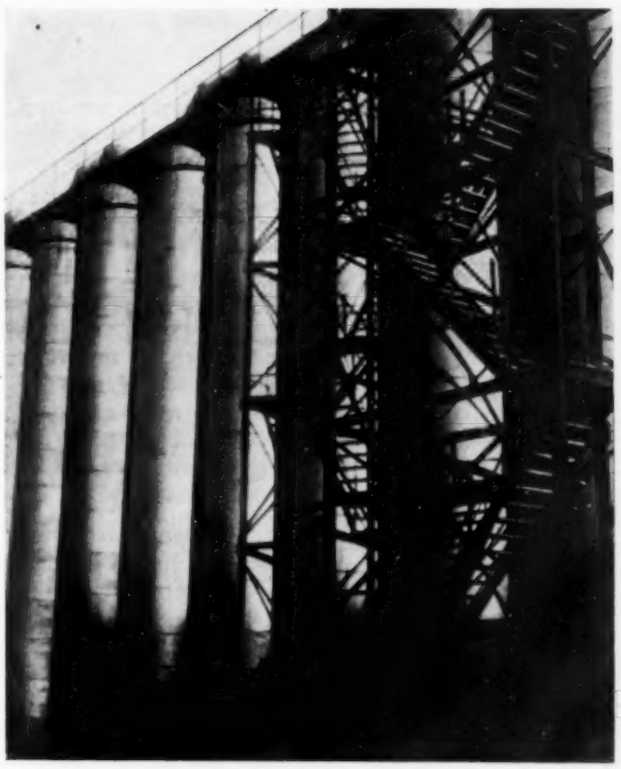
have sprung up in connection with the steel mills such as at Magnitogorsk, utilizing the byproducts from the coke ovens. The large power plant at Dnieper, in the Ukraine, has become the chief electrochemical center, producing chlorine and alkalis, calcium carbide and abrasives, oxidation agents, metallic sodium and magnesium, acetic acid and synthetic solvents. Among important developments must also be mentioned a large viscose plant near Leningrad and a rayon plant at Perm; a turpentine and rosin plant is in operation in the Gorky district, and the largest paint, varnish, and lacquer plant in the Soviet Union has been built at Yaroslav. Synthetic methanol and butanol and acetone are produced at Grozny and dyes and intermediates at Leningrad.

Russia's Synthetic Rubber

As Russia has no natural sources of rubber the question of supplying the growing demand for this material has been given much consideration. One potential source of supply has been found in a rubber-bearing root growing in Turkestan, cultivation of which is being encouraged by the government. Another solution is being sought in the manufacture of synthetic rubber. Large scale experiments on this problem were started in 1929. The results obtained were sufficiently encouraging to warrant the erection of a plant at Yaroslav which was put in operation in the summer of 1932. Two other plants have since been added, and two more are under construction at the present time. These plants have a capacity of 5,000 to 10,000 tons each, and it is hoped that this year's production may reach 40,000 tons.

In the process used, the so-called divinyl process, developed by Prof. Lebedev, ethyl alcohol is the raw material. It is passed over a catalyst to yield butadiene which again is polymerized by the aid of metallic sodium. Corn waste products and a special kind of potato serve as sources for the alcohol, but experiments are now being made to use ethylene and acetylene for this purpose. Although the cost of the process is still high, the domestic production of rubber releases foreign credit for other purposes.

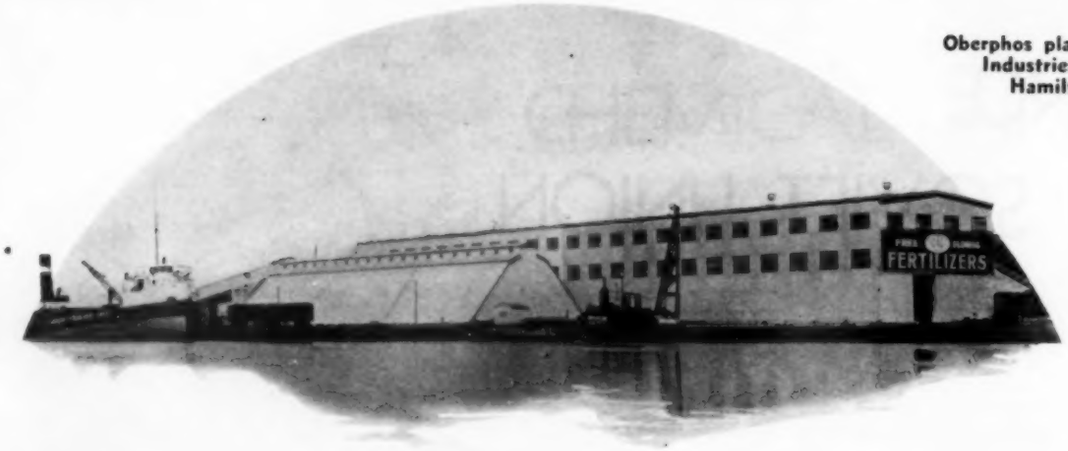
Progress in the petroleum industry has come up to the program mapped out. New refineries represent about 65 per cent of the present capacity. Gasoline production in 1932 reached 21,000,000 bbl., of which one third was exported. Five large refineries with 27 pipe stills and 24 new cracking units were completed during the first five-year plan. The second plan calls for the building of a new group of refineries with 46 pipe stills and 93 cracking units, and the laying of about 2,500 mi. of pipe lines for transportation of crude and refined products.



Stainless steel absorption towers in the nitric acid plant at Berezniki

In the construction of the new plants the aid of foreign engineers and technicians has been essential. Most of the chemical equipment was obtained from abroad, some from the United States, but the greater part from Germany. Some chemical apparatus is now being made domestically, for instance in a newly constructed plant in the Urals, but this will be far from sufficient to meet the great demand of the extensive new program.

Such a general expansion of technical and commercial activities would be impossible without an elaborate educational program, involving the training of skilled workers, technicians, and engineers. About 340,000 college graduates, 900,000 technicians, and 5,000,000 skilled workers will be affected by this program; the latter figure includes 2,500,000 workers in factory schools, 1,500,000 in agricultural schools, and 700,000 in automotive schools. Complete abolition of illiteracy among the adult population will be effected, and the introduction of a universal, compulsory system of elementary education completed. Total attendance at all educational institutions in 1937 will be about 36,000,000, compared with a little over 24,000,000 in 1932.



Oberphos plant of Canadian Industries, Ltd., at Hamilton, Ont.

NEW PROCESS GIVES IMPROVEMENT IN SUPERPHOSPHATE QUALITY

By M. SHOELD

Oberphos Co., Baltimore, Md.

FOR NEARLY a century acidulation of phosphate rock to produce superphosphate has been the most important method of making phosphate available for fertilizer purposes. Annual world employment of this material is about 15,000,000 tons, of which in the neighborhood of one-quarter is normally consumed in the United States. And yet, with this enormous production and in the face of the thousands of patents that have been issued, very few important changes in the methods of manufacture have occurred. The most recent of these appears in the Oberphos process, developed since 1926 under the sponsorship of G. Ober & Sons Co., in Baltimore. It was at this company's plant that the first unit for the new process was completed and put in operation in 1929-30. Since that time Canadian Industries, Ltd., has built two Oberphos plants, one at Beloeil, Que., and the other at Hamilton, Ont. One plant in England, that of Fison, Packard & Prentice, Ltd., has installed the process at Ipswich. Present negotiations of the Oberphos Co., of Baltimore, owner of the process patents, is expected to result in the early building of other plants of the same type. The four plants now in operation have produced upwards of one-quarter million tons of Oberphos.

Not only is the Oberphos process interesting because it is radically different from the den method of making superphosphate, but it also produces a granular, free-flowing and non-setting product of superior handling, mixing and use characteristics. Incidental to this primary feature of improved quality is a reduction in the acid requirement which may amount to as much as 60 to 65 lb. (50 deg. Bé.) per ton of superphosphate, coupled with the ability to produce a superphosphate of higher available P_2O_5 content than it is possible to produce directly by the "densuper" process, using the same rock.

When the development of the new process was first undertaken, it was recognized that any improvement in superphosphate would hinge upon an improvement in particle size, dryness and hygroscopicity. For superphosphate to be mixed with other materials (representing about 80 per cent of that used in the United States), its freedom from reactivity with such other materials is also important. Development of a granular, rather than a finely pulverized, material was known to be important in that this would give not only free-flowing qualities, but would tend to reduce hygroscopicity and reactivity because of the decrease in specific surface. A given weight of 100 mesh material, for example, has a surface area about 15 times as large as the same weight of material of 10 mesh size. The ratio of areas in actual contact, between the particles of the two sizes, is enormously larger and may be in the magnitude of over 1,000 times, depending on particle shape, pressure and other factors. The factors of total surface and contact area are, of course, important ones in controlling moisture absorption, setting and reactivity. Initial dryness of the material, also, is a determinant in that material of suitable physical form, with sufficiently low moisture content, will be non-setting even in the finer sizes.

As with the case of other processes, the Oberphos method did not spring full blown from the laboratory. The basic principles have remained the same, but there were numerous troubles with auxiliary apparatus that had to be smoothed out. Special designs were often necessary, and suitable construction materials had to be discovered. In the process as it is operated today, these initial difficulties have been overcome, and the present method is both simple and foolproof.

The principal piece of apparatus in the Oberphos plant is a closed, horizontal, rotary autoclave in which the

acidulation of the ground rock takes place under pressure. At the present time autoclaves have been built in capacities of 500 and 600 cu.ft., although sizes of 800 and even 1,000 cu.ft. are contemplated for future installations. The dimensions of a 500-cu.ft. autoclave are approximately 20 ft. long by 6 ft. in diameter in the middle, tapering to 5 ft. diameter at both ends. The taper facilitates rapid dumping of the finished charge through a manhole which is located in the middle of the shell. The shell may be either jacketed or single, although at the present time the preferred form is the single-shell autoclave, with provision for steam injection directly into the charge. The autoclave is rotated at 5 r.p.m.

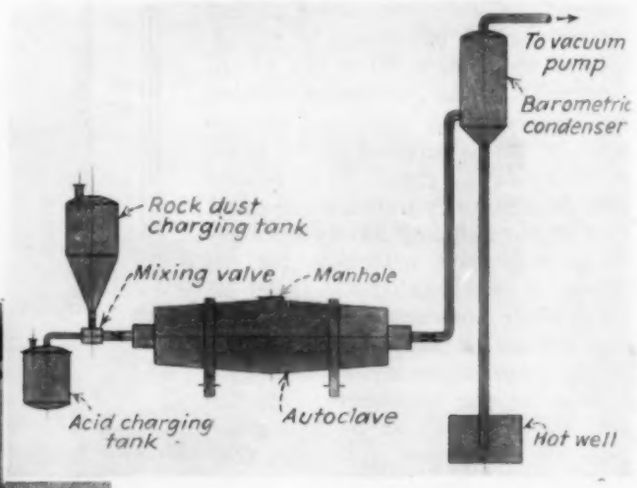
The drum is of riveted or welded steel with an autogenous lead lining which, surprisingly enough, is not worn by the charge but seems to have a more or less indefinite life. The reason for this is that a thin coating of material builds on the inside of the shell and protects the lining, remaining at a substantially constant thickness. It is another surprising fact that the material does not build up in any quantity on the autoclave walls, but comes out in nodular form. The reason for this appears to be that at the high temperature of operation, the calcium sulphate which is formed has a different crystal form than is encountered in densuper.

In conjunction with the autoclave there is equipment for the simultaneous charging of finely ground rock and acid and for evacuating the reaction vessel at the beginning and end of the process. The autoclave is provided with pipes at the ends, 6 to 8 in. in diameter, through which the charging and evacuating are accomplished. The inlet pipe leads from a special mixing valve installed in the circuit between the autoclave and the charging tanks. The rock-charging tank is a closed, cylindrical vessel with a conical bottom to which the rock (ground to a fineness comparable to densuper practice) may be transferred by means of a pneumatic conveying system, or by screw conveyors and a bucket elevator. This tank is equipped with a small vertical stirrer and compressed air inlets. Suitable valves are provided at the top and bottom. The acid-charging tank is an ordinary acid egg of proper size, equipped with charging and discharging valves.

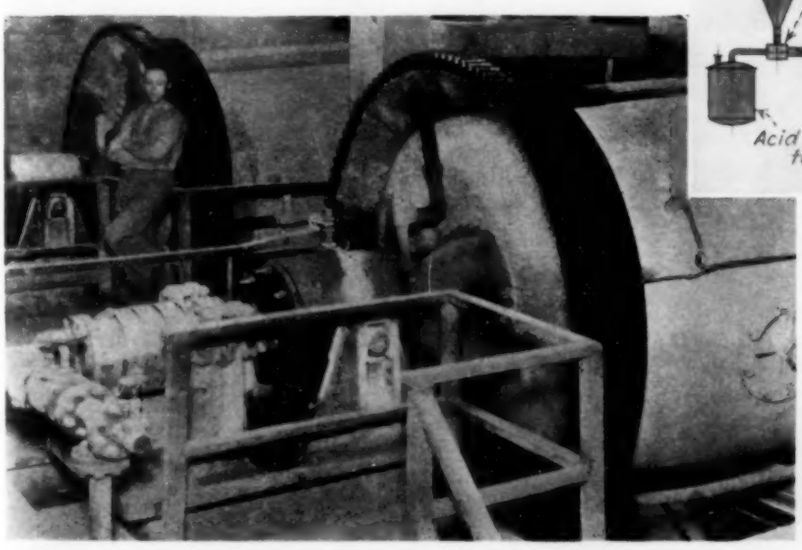
The acid used is of 50-55 deg. Bé., and its temperature, as charged, is 110-120 deg. F. When an unjacketed autoclave is used, the Baumé of the acid is 1-2 deg. higher than desired, to compensate for its dilution by steam.

Charging is accomplished by blowing the acid tangentially into the mixing valve, while the rock dust enters the valve at its center, thus effecting thorough mixing. Air at about 80 lb. gage pressure is used to blow the acid. So that this pressure may be maintained during the charging period, an air receiver is placed between the compressor and the tank. A pressure of 5 lb. of air is put on the rock-charging hopper when its stirrer is started. The rate at which both acid and rock enter the mixing chamber can be accurately controlled by the setting of the mixing valve, which is adjusted so that the materials enter in substantially the same time. This adjustment is easily altered for any given condition of charge, rock size, acid ratio, etc. While these conditions remain the same, the setting need not be changed. While preparations are being made for the charging, a vacuum is induced in the autoclave to the extent of about 28-29 in. of mercury.

The suction pipe by which the autoclave is connected to the vacuum system extends into the vessel in the form of a gooseneck, designed to make possible the carrying of a large charge without covering the outlet. A splash plate may be provided within the autoclave, although this is not absolutely necessary. The vacuum system consists of a direct-contact, barometric-type condenser, equipped with the usual baffle plates over which the condensing water cascades. Non-condensable gases are removed by a reciprocating, double-acting, piston-type



Equipment of Oberphos process wherein phosphate rock is digested with sulphuric acid at 300 deg. F. and 90 lb. pressure



Vacuum end of autoclaves in plant of G. Ober & Sons Co., Baltimore, Md.

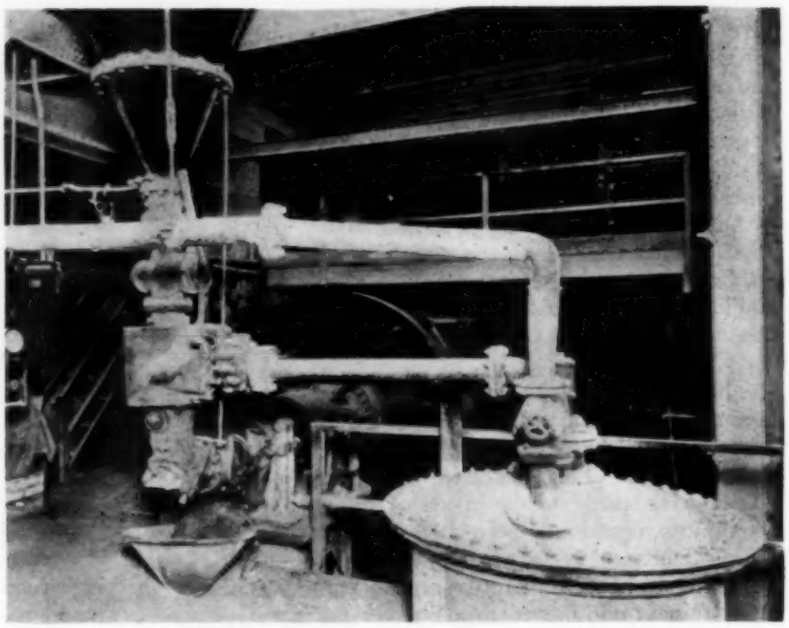
vacuum pump. The quantity of water used by the condenser is relatively large, for the purpose of protecting the vacuum pump, and may be of the order of 300-500 g.p.m.

Acidulating the Rock

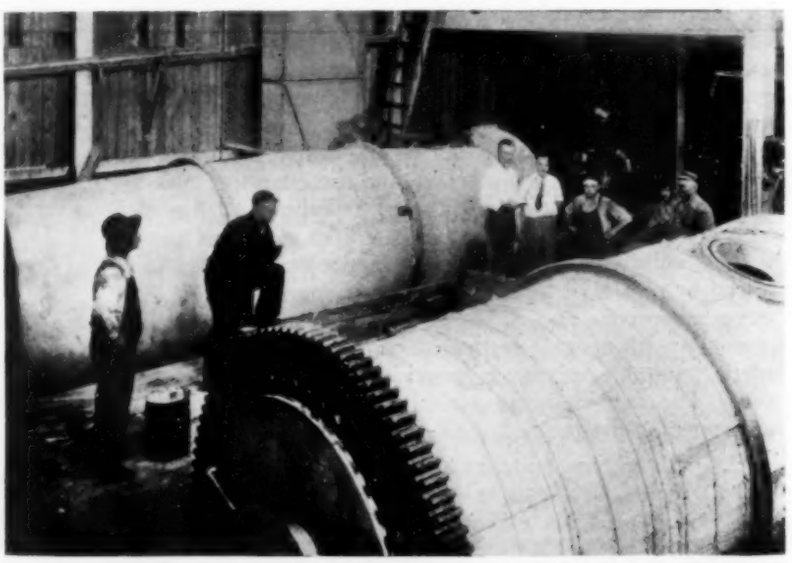
Operation of the process is as follows: When the autoclave has been evacuated it is started rotating, and this rotation is maintained throughout the process. Acid and rock are weighed into their respective charging tanks and then run into the autoclave, as described, in an average time of 60 to 75 seconds. This short time not only reduces the operation cycle to a minimum, but prevents the escape of steam with resulting loss of heat, so that the entire heat of reaction can be utilized in raising the temperature of the charge, thus facilitating the reaction and the subsequent drying. A further reason for rapid charging is encountered with some rocks which tend to foam when mixed with sulphuric acid. By means of rapid charging it is possible to introduce a full charge into the autoclave before any undue foaming takes place. But for this method, the foam might get into the vacuum pipe and cause trouble.

As soon as the rock and acid have entered the shell, it is sealed off and direct steam is introduced to the extent of about 30 to 50 lb. per ton of material. In the jacketed autoclave, however, steam is not introduced internally, but is supplied to the jacket at 40 to 50 lb. gage. It is evident that the steam requirements are small. In a plant producing 200 tons per day in an unjacketed autoclave, for example, a small automatic boiler of 7-12 boiler horsepower, in conjunction with an accumulator, will provide all the steam necessary.

Due to the exothermic reaction and the introduction of live steam into the unjacketed autoclave, the pressure developed within the drum is of the magnitude of 90 lb. per sq.in. In the jacketed autoclave, average pressures obtained range from 60 to 70 lb. In either case, the temperature of the mass is rapidly raised to 300 deg. F., or higher, and at this high temperature the acidulating reaction is extremely rapid. The pressure period is terminated in from 20 to 30 min. by blowing off the steam. Reduced pressure is then induced in the drum by means of the condenser and vacuum pump. The heat stored in the mass is sufficient to dry the material under vacuum. As its water evaporates, it falls in temperature to about 120 deg. F. During the drying period, which is about the same length of time as the pressure period, the material is not only dried and cooled but it is simultaneously granulated.



Rock- and acid-charging tanks and mixing valve in the plant of C. Ober & Sons Co., Baltimore, Md.



Single-shell autoclaves during installation in the plant of Canadian Industries, Ltd., Hamilton, Ont.

Following the drying, the vacuum is released, the manhole cover removed and the Oberphos dumped by rotating the autoclave for from 3 to 5 minutes. In present plants the charge is from 6 to 8 tons, but it is contemplated in future plants to use batches as large as 10 to 12 tons, compared with the average charge of 1 to 2 tons possible in a densuper mixing pan.

A discussion of the reaction is now in order. It appears that the high pressure employed is of no particular value in itself in facilitating the acidulation. Rather, it is the temperature that is obtainable under this pressure, without the loss of water, which accelerates the reaction.

As in the case of most chemical reactions, the reaction velocity doubles with a temperature increase of 18 deg. F. With an average temperature in densuper manufacture of 200 deg., the advantage of the temperature of 300 deg., or higher, obtained in the Oberphos process, is obvious. Further than this, despite the fact that heating acid superphosphate under atmospheric pressure to a temperature as high as 300 deg. F. reverts a considerable amount of P_2O_5 to unavailable form, at the pressure of the Oberphos reaction, reversion does not take place. In addition, with the maintenance of optimum acid concentration, the reaction proceeds in a satisfactory manner that could not be obtained were loss of water to take place.

Still a further factor here is that the crystallization or setting of the salts present in acid phosphate is substantially inhibited at a temperature of 300 deg. F. when water is present. In distinction to the sensitiveness of the densuper batch to premature setting, the mixture in the Oberphos autoclave is substantially fluid during the entire digestion period. As long as pressure is maintained, there is no setting. It is only when the pressure is reduced and the temperature of the mass lowered that incipient setting takes place. However, due to rotation of the autoclave, granulation results, yielding nodular particles ranging in size from 5 mesh to pea, nut and even fist size. Under average conditions, as much as 30 to 40 per cent of the product may pass through a 5 mesh screen.

It was mentioned above that certain types of rock exhibit a foaming tendency when mixed with sulphuric acid. This tendency appears not necessarily to be connected with the carbonate content. Probably the kind and quantity of organic material present in practically all phosphate rock has a bearing on this tendency. But, regardless of foaming properties of the rock, we have not found one that cannot be handled satisfactorily with the Oberphos process. Suitable size of charge, however, may vary somewhat with different rock.

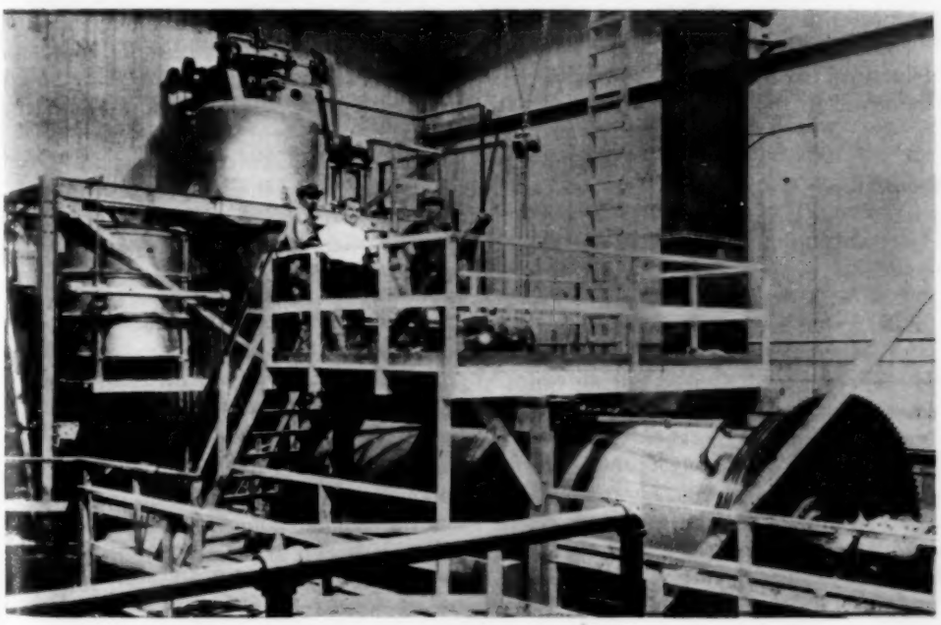
In the case of some phosphate rocks, there is slight tendency on prolonged, continuous operation, for the protecting layer of material on the lead to build up. To correct this condition a so-called "acid charge" is run, perhaps once a week. A charge of acid of the usual size is introduced into the autoclave and heated by means of a steam jacket or direct steam. The autoclave is operated with the acid for a period of one to two hours, which dissolves the coating on the wall. Then the usual quantity of rock is introduced in the standard manner, and the resulting charge carried through the regular digestion and vacuum periods. The resultant product, although of very fair physical condition, has a percentage of acidulation that is somewhat lower, about 2 per cent, than in a regular run.

Approximately 10 per cent of the fluorine content of the rock is driven off during the Oberphos process. This is about one-half the loss in the average densuper plant. Existing Oberphos plants are located near tidewater or on streams and do not recirculate the condensing water. With inland plants where recirculation is necessary, it would be very easy to recover fluosilicate compounds from the condensing water. However, at low current prices for such compounds, recovery is not advocated except in those cases where recirculation of the condensing water is necessary.

Finishing Oberphos

Moisture content of the Oberphos, as dumped from the autoclave, depends on the method of operation. With short-cycle operation of 20 to 30 minutes each for digestion and evacuation, the moisture content of the material is 8 to 9 per cent. With a steam-jacketed autoclave and a long drying cycle, the moisture can be brought down to 5 per cent or less. As it comes from the autoclave the material, although substantially dry, is still soft enough to be broken by hand. After standing for 24 hours, the individual nodules become very hard and require a hammer for breaking. They are then bone dry to the touch.

Before it can be used, Oberphos must be ground. This is currently done in a cage mill or swinghammer mill,



Steam-jacketed autoclave, rock-charging tank and acid weigh-tank, Canadian Industries, Ltd., Beloeil, Que.

following scalping over a regular tailing screen. The cost of grinding is very small, running in one plant, for example, to 3½ cents per ton, including all operating charges. When Oberphos is ground in high speed mills of the type indicated, a small quantity of fines is formed. A typical screen analysis is as follows:

Mesh	Per Cent Through	Mesh	Per Cent Through
10	96	80	20
20	72	100	15
40	40	150	8
60	26	200	4

It is believed that the use of a relatively slow-speed roller mill, employing step grinding and intermediate scalping, would reduce the quantity of fines to a minimum. This would particularly be the case with dried Oberphos. A simple pneumatic separation of fines in closed circuit has also been considered. In this case, the small amount of fines could be regranulated with fresh Oberphos charges by mixing it with the rock dust and returning it to the process.

Due to its granular and non-bulky nature, Oberphos is heavier than densuper, volume for volume. Oberphos weighs about 75 to 80 lb. per cu.ft., against about 60 lb. for densuper.

As the material is ordinarily produced, containing 8 to 9 per cent moisture, it is not entirely non-setting, although it is much superior in this regard to densuper. To produce a non-setting material, it is necessary to bring the moisture content down to about 3 per cent. At this point the material is absolutely stable, permitting substantially no further after-curing. Carrying the moisture content below about 5 per cent causes some reversion to water insoluble form, although this material is citrate soluble and available, according to American standards.

Since bringing the moisture content down as low as 3 per cent would unduly prolong the cycle in the autoclave, a better method of operation is to use a relatively short cycle in the autoclave and complete the drying in a small concurrent direct-heat dryer. When this is done, the water elimination may be visualized by the following example. With 1,000 lb. of rock and 861 lb. of 53 deg. Bé. acid, about 291 lb. of water, representing 15.6 per cent of the total charge, will be eliminated. Of this about 10 to 12 per cent will be driven off in the autoclave while the remainder is later removed in the direct-heat dryer.

Dryer Causes no Reversion

It is remarkable that even with large throughput there is no reversion of the P_2O_5 to unavailable form in drying Oberphos. In one plant, for example, a dryer with a diameter of 40 in. and a length of 27 ft. has a capacity of about 200 tons per day down to 3 per cent moisture. The cost of this additional operation is very low. Concurrent direct-heat dryers may be operated with any desired form of fuel. Drying is accomplished before the final grinding. When direct-heat drying is used, the Oberphos is generally allowed to stand for 2 to 4 weeks for final after-curing before drying and grinding, except that when immediate shipment is required, the material may be dried at once. On the other hand, such drying is not an essential operation and in fact is not used, because of its recent development, by the majority of the existing plants.

Additional fluorine compounds are driven off in drying, to the extent of about 10 per cent of the total fluorine present in the rock. Under average conditions, the stack gases do not constitute a nuisance, but in the case of locations in thickly settled surroundings, suitable scrubbing towers should be provided.

Process Gives Higher Availability

An accompanying table gives typical analyses of Oberphos produced from various types of rock. In the introduction to this article, it was pointed out that by means of the Oberphos process, a higher availability of P_2O_5 was possible for a given rock than by the densuper process. This is particularly of advantage in those territories where an increasing demand for 20 per cent available P_2O_5 superphosphate, rather than the old standard of 16 per cent, exists. In the analysis for Florida rock given in the tabulation, it is evident that a 70-72 B.P.L. rock gives better than 20 per cent availability by means of the Oberphos process. Using the densuper process on the same kind of rock would produce a material containing slightly over 18 per cent available P_2O_5. To make a 20 per cent available product, with the latter process, it would be necessary to go to a higher priced rock of about 75-77 B.P.L. Hence, based on current prices in eastern United States, the cost difference in favor of the Oberphos process amounts to about 80 cents per ton.

Oberphos Analyses for Various Types of Rock

	Florida, 71 B.P.L.	Moroccan, 75 B.P.L.	Gafsa, 57 B.P.L.
Rock			
Acid per 100 lb. rock	92	92	90
Acid Basis, deg. Bé	50	52	52
Production conditions			
Drying	dried	none	none
Curing time	1 month	4 months	48 hrs.
Analysis			
Total P_2O_5, per cent	20.8	21.0	16.7
Available P_2O_5, per cent	20.1	20.7	16.38
Water-sol. P_2O_5, per cent			15.90
Insoluble P_2O_5, per cent	0.7	0.3	0.32
Moisture, per cent	2.9	5.1	8.7

With a Gafsa rock of 57 B.P.L., as shown in the third column of the table, the Oberphos process would produce an available P_2O_5 content of 16.38 per cent and a very high water-soluble content of 15.9 per cent, in comparison with 13.5 per cent water-soluble P_2O_5 that would result, on the average, with the same rock in the densuper process.

The percentage of acidulation of the Oberphos from the autoclave depends largely on the acid-rock ratio used. This will generally run from 88 to 95 per cent within 24 hours. On storing the material 2 to 4 weeks, the acidulation will increase to from 92 to 98 per cent. Storage of from 4 to 6 months will increase the acidulation to from 95 to 99 per cent. These figures which, of course, are only approximate and general, show an after-curing quite similar to densuper.

In closing, it is desirable to emphasize that the primary accomplishment of the Oberphos process is the production of a material of superior physical properties and superior availability. As an incidental advantage, savings result from the smaller quantity of acid required and the ability to use a lower grade rock than that required for an equal degree of availability by the densuper process.

100,000 gal. of rye or bourbon whiskey may be produced per day in the Peoria, Ill., plant of Hiram Walker & Sons

World's Largest Distillery Nears Completion

By LLOYD C. COOLEY
Hiram Walker & Sons, Inc.
Peoria, Ill.

TELLING of the size of the Peoria, Ill., plant of Hiram Walker & Sons, Inc., is merely a starting point. The important thing is to realize how well the skill of the architect has been combined with the knowledge of the mechanical and chemical engineers to produce an efficient plant. No expense has been spared to obtain equipment which will have long life and which will require a minimum of maintenance. Emphasis has been placed on continuous and automatic operation using the latest ideas based on mechanical and chemical engineering principles.

Built to make whiskey, either rye or bourbon, the stills will produce in one 24-hr. day 100,000 gal. Part of the equipment can produce high-proof spirits at a rate of 25,000 gal. daily. Byproducts will be fusel oil and dried grains for feed while head and tail products will go into denaturing grade alcohol.

Steam will be supplied by two Sterling-type Babcock & Wilcox boilers, with Bailey water walls, rated at 1,875 boiler hp. each, operating at 250 lb. pressure with 110 deg. superheat. It is estimated that a daily maximum of 350 tons of coal will be burned, using a washed coal pulverized in one B&W Type B, and one Kennedy Van Saun pulverizer, each of 10 tons hourly capacity, supplemented by a 3-ton Fuller Lehigh which can be swung under either boiler. Burners will also be provided to use natural gas for light loads and Sunday work. A Ljungstrom air preheater will send out air at 450 deg. F., cooling hot gases from 650 deg. to 400 deg.

Water will be softened in a NeKar softener using lime and soda with continuous blow down. Elliot feedwater and Cochran deaerating heaters will be used. The high-pressure steam will drive two General Electric 1,500-kw. turbines at 3,600 r.p.m., operating at 20 lb. back pressure and bleeding off at 70 lb. to cookers and dryers. The 20-lb. line will be 20 in. in diameter, running to the stills.

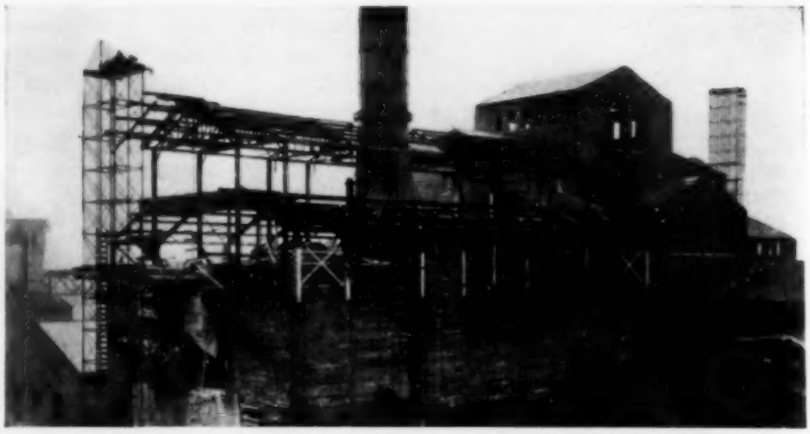
By an agreement with the local power company, the Hiram Walker generators will furnish power outside the plant. One of the major heat loads, which consequently is to be housed under the same roof as the boilers and power units, will be five rotating Tyler-Harmon steam-tube dryers to handle still slop after treating in Davenport screens and presses. Each dryer will produce 112 tons of dry grain in 24 hr. It is estimated that they will use 17,000 lb. of steam hourly. These dryers are 28 ft. long and 8 ft. 6 in. in diameter.

The processing departments: milling, cooking, yeast making, fermenting, and distilling, will be housed in a building 293 ft. long by 138 ft. wide. An automatic elevator will serve all floors in the mill up to and including the sixth.

Corn, rye, and barley malt will be unloaded from cars by the Fuller Airveyor system. Grain will be cleaned and weighed, then stored in concrete bins up under the roof. From these bins the grain will be fed through

remote controlled gates to 12-roll (three high) Allis-Chalmers mills, then elevated to the steel meal bins at the top of the building.

The cookers will be eight in number, of 300 bu. capacity, equipped with direct motor-driven agitators. These cookers are designed to operate at 70 lb. pressure and will be cooled by blowing down through a mash trap to a Griscom-Russell Bentube heat exchanger, and then by flashing to vacuum condensers. Grain, malt, hot water and steam to the cookers and the venting, cooling and dumping will all be controlled by motor-operated valves from a central switchboard with four panels—one for each pair of cookers. These panels have push-buttons operating conveying systems Nos. 1 to 6 incl., as well as indicators to show which system is operating.



Power building as it appeared in March. In the background is the mill

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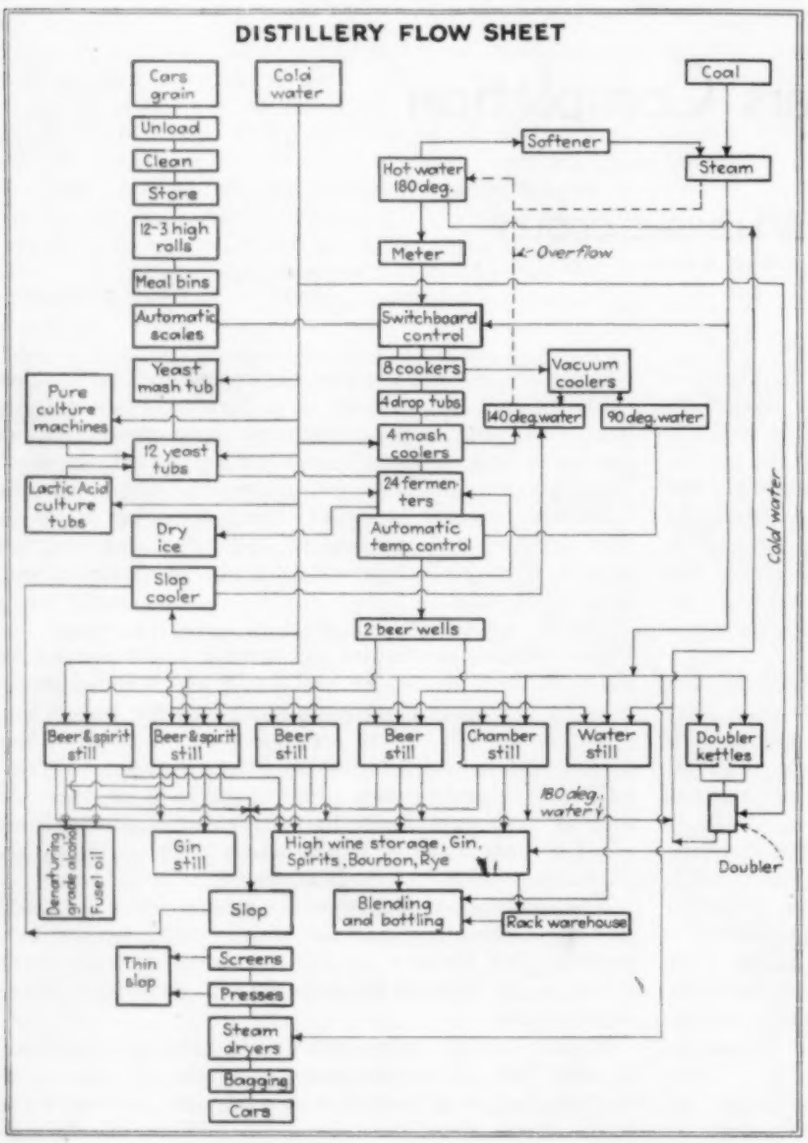
Flow sheet of the bourbon and rye distillery of Hiram Walker

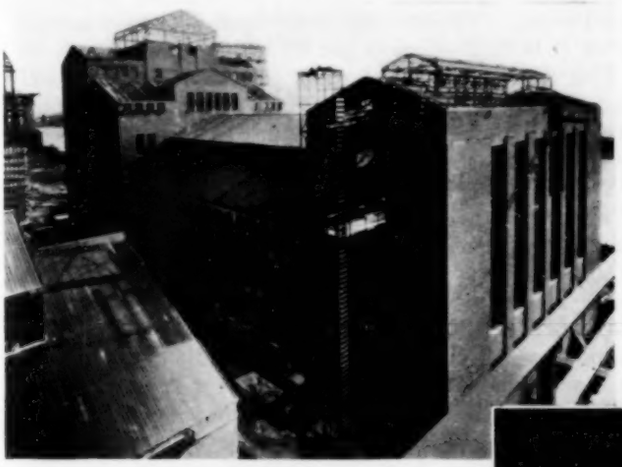


A typical example of operation follows: The operator opens the dry meal valve on any cooker, and a contact on this valve energizes the control system. He then presses button No. 6 on the control panel, which moves the motor-operated selector switch to the proper position to run No. 6 conveying system to the selected cooker. By pressing the waster push-button the system is then started, the conveyor commences to run, the gate opens under the meal bin, and the scales are energized. When the proper quantity of barley malt has been weighed out a contact on the scales closes and opens a timing relay. At the end of the predetermined time the conveyor will stop and the gate will close. An indicator on the control panel tells when the system is operating. When the operation of system No. 6 is completed, the operator selects a second system to charge dry corn or rye meal in a similar manner, and the operation proceeds as described. The dry meal valve is then closed.

After a given interval, the operator opens the wet meal valve and selects the proper conveying system as before. To start this he presses the master button, and the conveyor begins to run, the grain gate is opened, the mixer is started, and the water valve, which energizes the scales, is opened. When the material has been weighed and dumped into the mixer, a contact on the scale will close, energizing a timing relay. After a predetermined time the water valve closes. A second timing relay is then ener-

gized and at the end of the second period the mixer and conveyor are stopped. The gate is then closed, and the system is ready for carrying through another charge.

The selector set-up switch will consist of a motor-operated dial switch with a 110-volt motor and the proper number of contacts to complete the set-up circuits. The relay board will consist of five panels enclosed in a steel cabinet with doors at front and at rear. This board will contain all the necessary interlocking relays and timing relays necessary for proper operation. Four small control panels will be supplied, each equipped with the necessary push-buttons and indicators to control a pair of cookers. Fifty reversing starters



Processing building. The low section in the center is the fermenter room

for the gate motors are also included.

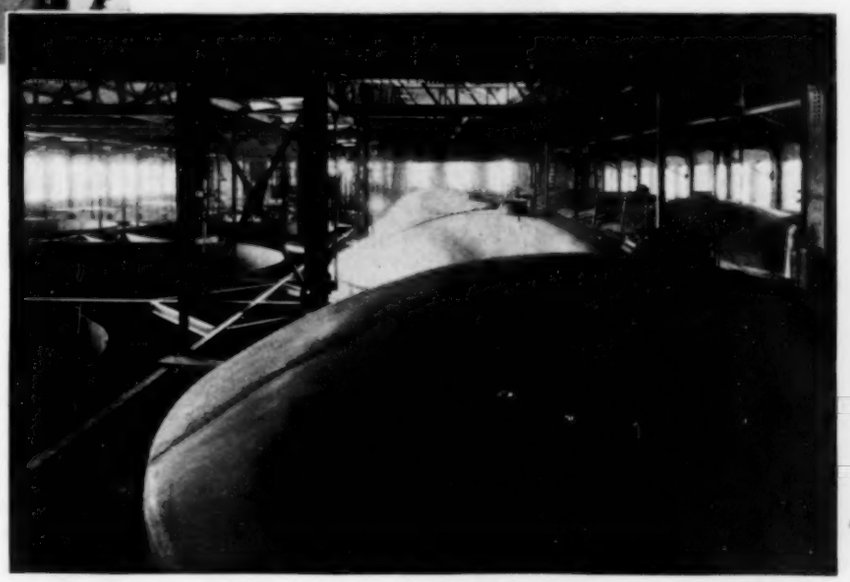
After the cook is finished the charge will be dumped to one of four drop tubs, each connected to a double-pipe mash cooler containing 22 copper tubes through which the mash will be pumped. Cooled mash will then go to 24 closed-top fermenters of copper-bearing steel, each with a working capacity of 110,000 gal. Each fermenter is 26 ft. in diameter x 18 ft. 8½ in. high on the straight section, with a conical bottom attached to the shell by a fair curve. The load is 1,000,000 lb. when full. During the 72-hr. fermenting period the temperature will be controlled automatically by Tagliabue instruments and water-cooled coils. Carbon dioxide will be carried to a solid carbon dioxide plant after removal of the alcohol content in scrubbers.

For the manufacture of yeast, there will be supplied two pure culture yeast machines, on the fifth floor of the mill building, means being provided for filling with wort if desired. Either machine can supply yeast to one of 12 yeast tubs located on the fourth floor level in a room finished with special smooth surfaced brick and with a granolithic finished floor. Yeast growth is controlled by automatic, temperature-sensitive equipment which starts the motor of the agitator in the yeast tub and opens the valve for cooling water. When the temperature has fallen to the lower limit the regulator first stops the flow of water, and then the agitator. Similar equipment, either for heating or cooling, is employed for controlling the growth of lactic acid used in the yeast mashes.

At the end of the fermenting period the beer will be dumped into a trough under each row of fermenters, running into the two beer wells. The latter are rectangular tanks set in a concrete pit under the last four fermenters.

For distilling, the beer will be pumped out of the wells by three direct motor-driven centrifugal beer pumps, capacity 450 g.p.m., to constant level tanks, then to proportioning pumps and through vapor and slop-heated heat exchangers to feed Badger, Ansonia, or Vulcan beer stills and the three-chamber rye stills. Operations will be controlled from the third floor, which is at the same level as the control floor for the cookers and fermenters. Most of the steam supply will be at 20 lb., although some 70 lb. steam will be used. The total quantity of steam to each still will be controlled by regulators actuated by the vapor pressure of the stills themselves. Likewise, the amount of cooling and condensing water will be controlled automatically by the vapor pressure from each still.

Within the processing building showing the fermenters under construction



A cold water constant-level supply tank will be furnished, and the hot overflow from the partial condensers or dephlegmators will be pumped to hot water storage. In fact the problem of heat conservation in hot water has been given serious study. Warm water from the mash coolers will go to 140 deg. F. storage, cooling water from the fermenters at about 75 to 80 deg. F. will go to the vacuum coolers on the cookers and thence to the 140 deg. F. tank. Water at 180 deg. F. overflows from the still condensers and is used in the cookers,

yeast tubs, wort tub, and Porteous mixers, for mixing dry grain and water. Waste grain slop from the beer stills will be used in heat exchangers to heat in-going beer and then will be pumped to the dryer house for screening, pressing, and drying. Whatever proportion of slop is to be used for mashing will be cooled in a duplicate of the mash coolers.

In addition to whiskey, high-proof spirits will be made in two continuous units built by E. B. Badger & Sons Co. and provided with central operating control and automatic steam and water regulation. Each unit is made up of a beer still, aldehyde separating and concentrating column, rectifying column with the necessary vent coolers, partial condensers, calandria heaters, whiskey and spirit coolers, thermometers and pressure bottles.

Oils will be cooled, diluted, washed, and redistilled. Whiskey or spirits will be drawn off, cooled and run from the tail boxes across a pipe bridge to the high-wine storage tanks in the next building.

There are two bourbon stills, one built by Vulcan Copper & Supply Co., and the other by Ansonia Copper & Iron Works. Each will have a daily capacity of 12,500 proof gal. One still will be heated by a Leader Industries reboiler or indirect heater.

To secure certain desirable qualities in rye whiskey the practice has been established to use an intermittently operated three-chamber still. Such a still is operated by blowing the contents of the boiled-out bottom chamber into the slops, then dropping the contents of the next upper chamber to the bottom and that of the top chamber to the one below. Into the top chamber is flowed a charge of beer and the steam is again turned on. All these operations take place in a 27-min. cycle and require so much of one man's time that automatic devices and remote-control valves will be supplied to the chamber still for the new plant. The chambers are deep, allowing for the retention of a large quantity of beer so that the boiling and reboiling not only exhausts the alcohol but causes some ester formation and the vaporization of desirable volatile acids.

By means of a walking-beam proportioning pump, beer and slop will be pumped to their respective channels in a charge preheater. To complete the roster, there will be a gin still and two whiskey doublers. An automatic elevator will serve four floors.

The products of the still house will be conveyed in pipe lines across a bridge to the high-wines building, which contains 18 copper tanks, 12 of which have a capacity of 28,000 gal., or a little over a day's run of spirits, while the remaining six hold 6,800 gal. each. From these tanks the spirits or whiskey will be pumped to the cistern building which contains another 18 copper tanks and also enamel-lined distilled-water tanks, to be used for gaging, proofing, and diluting to standard proof the whiskey before drawing to barrels. The copper equipment, stills and tanks will have cost $1,000,000 when installed.

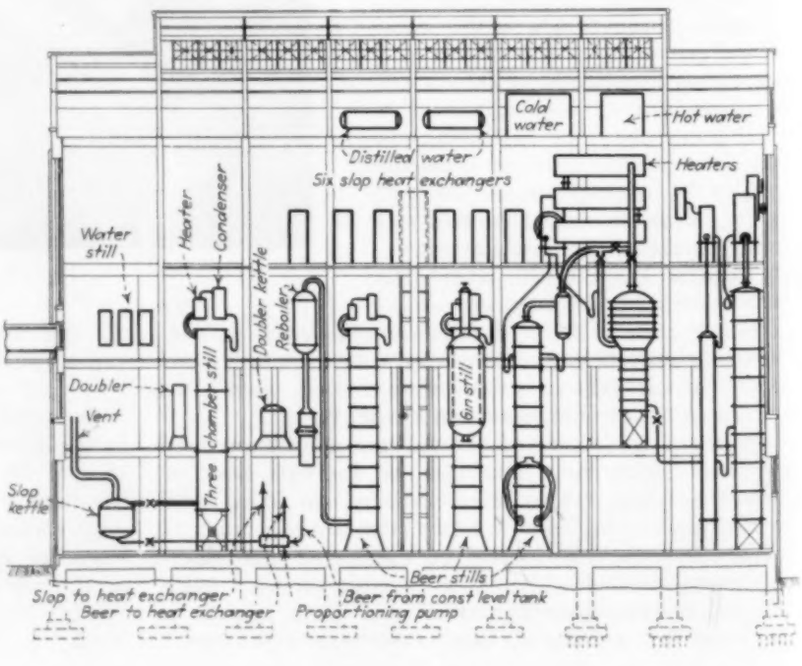
When the whiskey has been placed in barrels it will be stored in rack warehouses for aging. Two warehouses have been built to house 67,000 bbl. each. In the construction of each warehouse, 1,250,000 b.ft. of lumber and 1,500,000 bricks were used. The warehouses are equipped with the necessary heaters and fans to circulate heated air at the desired temperatures.

The bottling building is a four-story concrete and brick structure 318 ft. in length by 100 ft. in width. This building provides storage for packaging supplies, and has glass-lined blending tanks to feed five automatic lines of filling, capping, labeling, and cartoning operations. A large space is also provided for storage of cased goods. The bottling department is to have a capacity of 30,000 12-qt. cases per 24 hr.

The water for the plant is provided by three wells each of which produces 2,000 gal. per min. An unusually commodious and well-equipped machine shop and service building assures prompt repairs.

With a management so well grounded in chemical technology one can easily appreciate the emphasis which will be placed on chemical research and control. There will be three laboratories for the various divisions of the work, research, biological, and control. The research laboratory will be located on the fifth floor of the mill building which is served by an automatic elevator. The biological laboratory is on the same floor level at the opposite end of the mill, looking out over the river, while the control laboratory is in the upper part of the power house, near the water softener.

The operating staff is headed by H. F. Willkie, vice-president in charge of production, who has had many years of experience in operating and research. Thanks are due to him for permission to write this article, and to Smith, Hinchman and Grylls, architects, for their co-operation and for drawings and blueprints supplied.



Stills and other equipment in the Peoria plant

How to Prepare for Chemical Equipment Design

By DONALD F. OTHMER

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Polytechnic Institute of Brooklyn
Brooklyn, N. Y.

THE CHARACTERISTICS required by the successful designer of chemical equipment are essentially the same as those of the designing engineer in most other fields with the exception, that a highly developed imagination is usually of somewhat greater value. The method of attacking any certain problem and the importance attached to the various steps in a process will differ with the individual. One may start by delving into mathematical formulas, another may attack the physical chemistry of the reactions involved; one may proceed by shaping odds and ends of equipment into a pilot plant, while still another has production costs and sales campaigns foremost in his mind. One of the administrative type again may roughly outline the various steps and the organization required. Each lets his thought follow his own line of interest; and given an open field most men will unconsciously gravitate toward the field for which he is best adapted.

Passing to the fundamentals in the training of an equipment designer we must first realize that like most professional knowledge, this is an integration of various patterns. While the need for an education can hardly be overemphasized, it must be kept in mind that the schools, to cover a sufficiently wide field, can only teach the most fundamental principles, while most equipment is custom designed and custom built, with only isolated standardized items subject to mass production. Most of the methods, knowledge and formulas which make the difference between success and failure in design is, therefore, not only the stock in trade, but the unpurchasable merchandise of the equipment companies and the independent designing engineers.

College Education a Pre-requisite

In these days of competition, a bachelor's degree or an advanced degree from a recognized school is almost a pre-requisite. Fortunately, these degrees may be acquired from many schools in evening courses, permitting those men who have too early left school for industry to obtain the same advantages as those who have first completed their college work. Published material, engineering books, periodicals, catalogs, and company bulletins come next. One of our leaders in chemical equipment design has said that he learned engineering practice in general and his field in particular by reading advertising matter. A corollary to this is plant inspection and examination of processes and equipment whenever the opportunity presents itself.

But probably the most valuable phase of the background is the experience bought in concrete form in well designed equipment, acquired in discussions with others, and—most important of all—picked up by oneself in development projects, construction, and operation. This does not mean that the value of the formal education should be discounted, because this education provides the foundation on which to build an intelligent experience.

Engineering design is rarely the result of rigorous mathematical calculation; more often it is based on experience in the application to the problem of incomplete data, and incomplete knowledge of operating characteristics. Judgment seasoned by past attempts in comparable work is necessary in order to obtain any practical design, and to cut down to a reasonable size the factor of safety required.

Failures of plants and equipment may be divided into two classes, technological and economical; and the engineer may be responsible for either. The chief bulwark against serious failures is the continuous increment of operations from the smallest possible scale to the finished stages in a number of steps rather than in a single jump. A safe system to follow is the decimal system, each successive step being on the scale of not over 10 times that of the preceding. Mistakes in design and faulty procedures may thus be caught before they reach dangerous proportions, and improvements may be made at each step as the work progresses. Operations are rarely conducted on such large scales that more than four such steps would be required. The economic features should be studied simultaneously with the technical in the development work.

Obsolescence

The question of obsolescence is of particular moment in the rapidly changing chemical industry, where a new research may topple over the house of cards almost overnight. Only in the most standardized industries may one look ahead and gamble that the process and equipment may have a longer life than five years. In most cases, if the contemplated changes cannot pay for the equipment within that period, the equipment will not be purchased, and in many industries the period of amortization will have to be even shorter.

In general, the more costly and presumably efficient a machine is, the less the operating changes will be. Thus, if more money is expended for a better pump, the cost for power to drive that pump should decrease to offset the increased carrying charges. In most cases it would be folly to carry this to the absurdity of trying to guarantee the last fraction of a per cent of efficiency, because the original cost of such a pump would be so high that the carrying charges would overbalance the saving in power. The time to stop in the search of efficiency is at the point where savings realized by increased efficiency balance the increase in carrying charges. Another way of expressing this is, that the sum of carrying and operating charges should be a minimum.

In mathematical terminology, the first method is to take the respective derivatives of the two curves of operating and of carrying charges versus efficiency and determine the particular efficiency at which the two derivatives are equal in value but of opposite signs. The second method equates the first derivative of the summation curve to zero, and solves for the most economical efficiency. The application of this rule is an interesting but sometimes tedious problem in applied economics and should be undertaken where an installation of any considerable size is contemplated.

Vapor Pressures of Nitric and Sulphuric Acids

By J. H. PERRY and D. S. DAVIS

Respectively
Grasselli Chemical Co., Cleveland, Ohio, and
D. S. Davis' Associates, Watertown, Mass.

EXTENSIVE use of the available data on the vapor pressures—total and partial—of sulphuric and nitric acids makes it desirable for a large number of chemists, physicists, and engineers to have this information in as accurate and convenient a form as possible. Alignment and line-coordinate charts, of course, meet these conditions admirably and their use, in connection with many types of technical endeavor, has increased markedly during the last few years.

The application of the line-coordinate chart, in particular, to the vapor pressure data of these two most commonly used heavy chemicals is believed to warrant the presentation of the accompanying diagrams, older forms of which have been profitably used by one of the authors for some time. These charts should be of value to the manufacturers and users of the individual acids and should also prove to be a convenient source of information to laboratory men, to those handling these chemicals and those concerned with sulphonations, nitrations, and other operations in which sulphuric and nitric acids play important parts. Similar detailed charts for total vapor pressure of sulphuric acid and for partial pressure of water over strong sulphuric acid solutions have already appeared in *Chem. & Met.*, page 77, February, 1934.

The data used in the construction of the present charts are taken from "International Critical Tables," Vol. 3, p. 303, and are supplemented by later data from "Eine einfache Methode zur Messung kleiner Dampfdrucke," by W. V. Meyeren (*Z. physik. Chem.*, (A), Vol. 160, 1932, pp. 272-8), and "The Vapour Pressure of Water Over Sulphuric Acid-Water Mixtures at 25 deg. C., and its Measurement by an Improved Dew-point Apparatus," by J. R. I. Hepburn (*Proc. Phys. Soc.*, Vol. 40, 1928, pp. 249-60).

No attempt has been made to determine empirical equations connecting percentage of acid, vapor pressure, and temperature. For the purposes of the line-coordinate charts it is sufficient, in the case of but two of the variables, to choose functions which shall be linear one with the other. These functions are plotted along the parallel axes while the curved scale represents the third variable.

The captions of the several figures identify their purpose and range as well as the linear functions involved. Total and partial pressures in millimeters of mercury are represented by P and p, respectively, while T is degrees C. temperature and x represents the percentage strength of the acid.

Fig. 1—Total pressure over nitric acid-water mixtures in the range from 20 to 80 per cent nitric acid; linear function, log P vs. 1/T

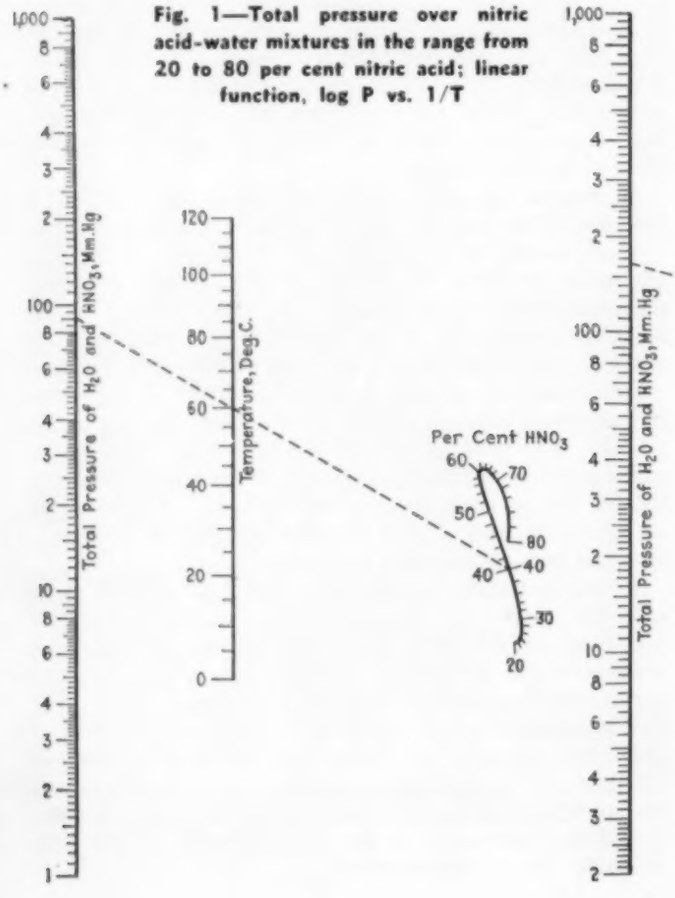
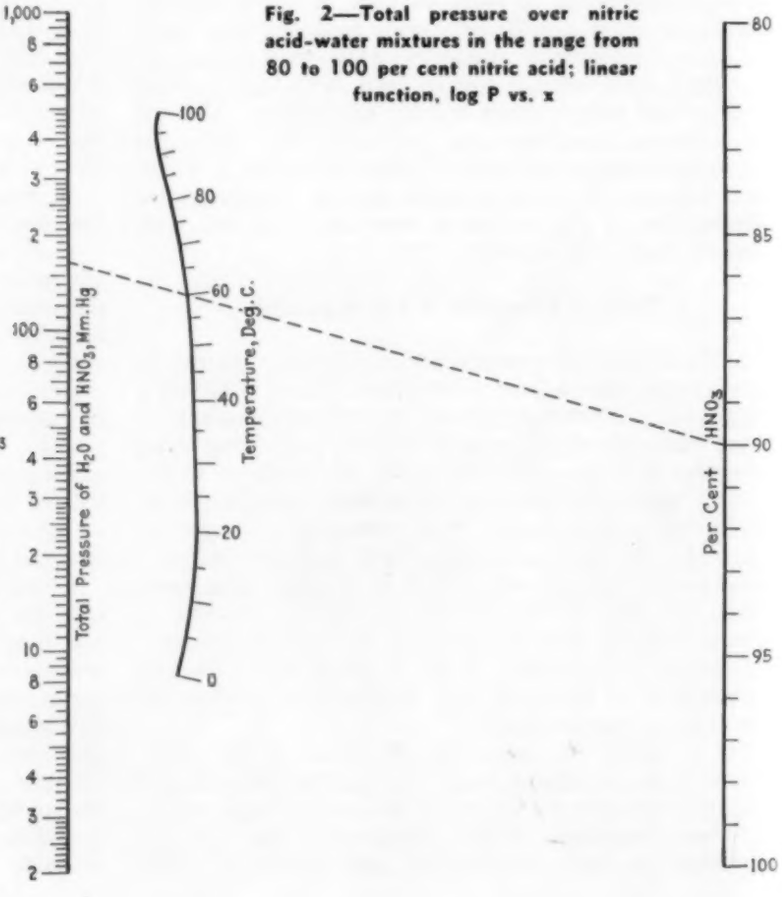


Fig. 2—Total pressure over nitric acid-water mixtures in the range from 80 to 100 per cent nitric acid; linear function, log P vs. x



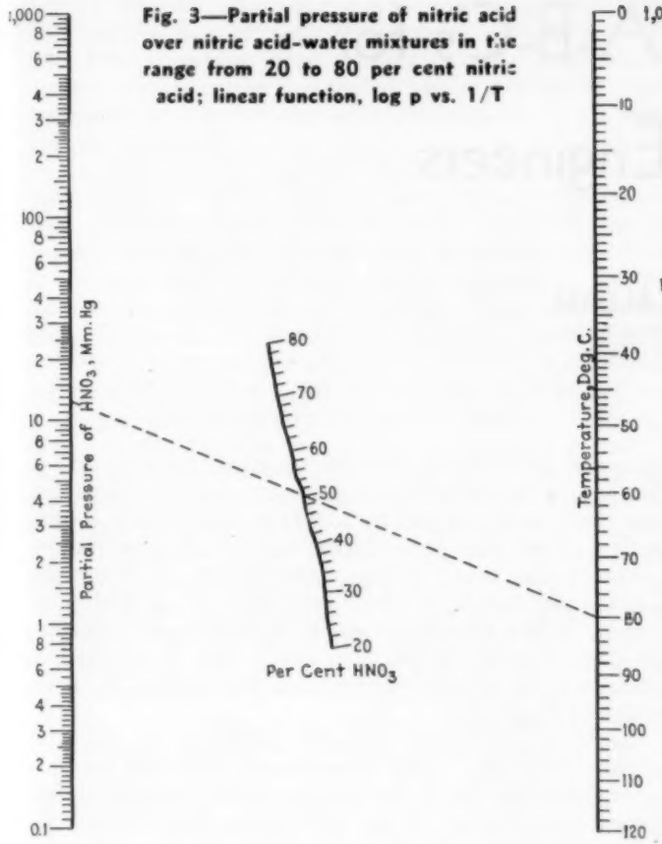


Fig. 3—Partial pressure of nitric acid over nitric acid-water mixtures in the range from 20 to 80 per cent nitric acid; linear function, log p vs. 1/T

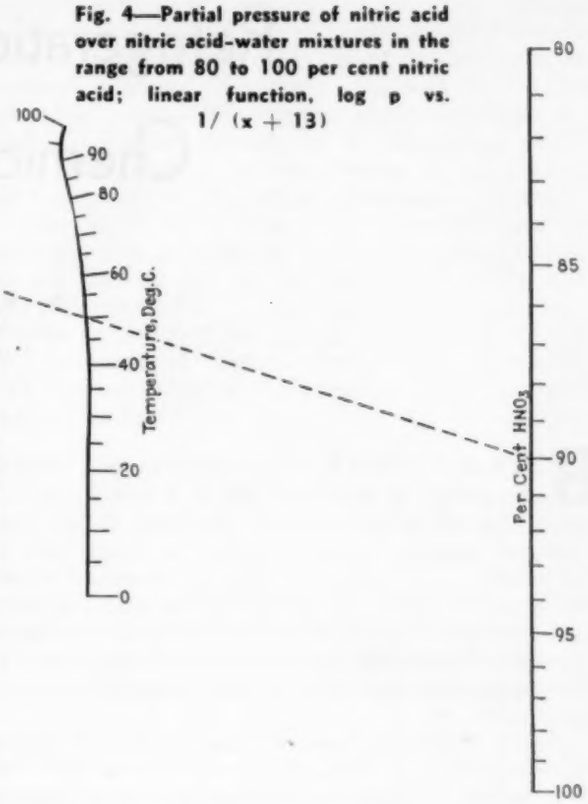


Fig. 4—Partial pressure of nitric acid over nitric acid-water mixtures in the range from 80 to 100 per cent nitric acid; linear function, log p vs. 1/ (x + 13)

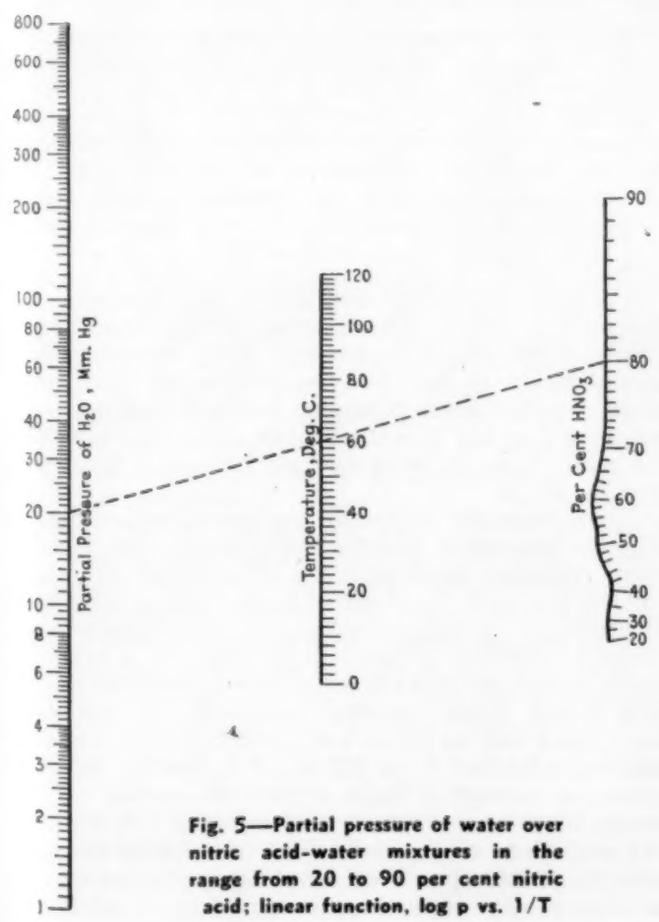


Fig. 5—Partial pressure of water over nitric acid-water mixtures in the range from 20 to 90 per cent nitric acid; linear function, log p vs. 1/T

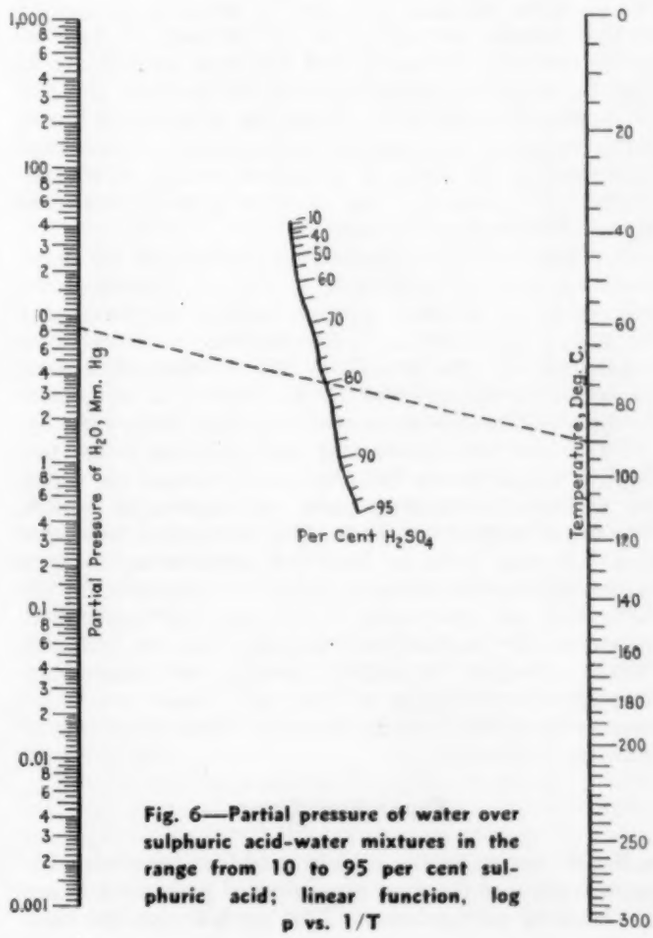


Fig. 6—Partial pressure of water over sulphuric acid-water mixtures in the range from 10 to 95 per cent sulphuric acid; linear function, log p vs. 1/T

Refrigeration A-B-C's for Chemical Engineers

By F. L. KALLAM
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BROADLY SPEAKING, refrigeration is the process of cooling or heat removal at a temperature level below that of the atmosphere. As such, it provides the chemical engineer with a means to attack and solve his problems of precise control of reaction rates and the exact separation of mixed materials. The purpose here is to present in an elementary way the fundamental principles underlying the operation of modern refrigeration apparatus applicable in the chemical process industries.

Just as mechanical power is measured in horsepower, so refrigeration is measured in commercial tons. When it is stated that a plant develops a certain number of commercial tons of refrigeration, the meaning is that the cooling effect, or quantity of heat abstracted by the plant, is the same as could be obtained by melting of that number of tons of ice per 24 hours. As 1 lb. of ice will absorb nearly 144 B.t.u. in melting at 32 deg. F., 1 ton of refrigeration is the removal of 2,000 × 144 or 288,000 B.t.u. Since the commercial ton of refrigeration is the rate of removing this number of heat units in 24 hours, it is also equivalent to the extraction of 12,000 B.t.u. per hour, or a more convenient figure, 200 B.t.u. per minute.

A plant of 2 tons refrigeration capacity does not mean, however, that it could make 2 tons of ice, since the process of ice making requires cooling the water to a freezing temperature and compensating for other losses before any ice can be made. The number of tons of ice which it can produce in 24 hours will in general be equal to 50 to 70 per cent of its refrigerating capacity.

There are four outstanding methods used in producing low temperatures, *i.e.*, the use of natural ice, freezing mixtures, expanding gases and vaporizing liquids. The use of natural ice is the oldest method of refrigeration, but aside from its historical importance, is of no consequence in the chemical industry. Economically the method is not practicable for commercial application. Likewise, the method of freezing mixtures, wherein salt is dissolved in water, lowering its temperature through the absorption of heat of solution is without practical importance to the chemical industry because of its many limitations.

Expanding Gases

No discussion of the subject would be complete without reference to the free expansion of gases as a means of obtaining refrigeration. This method employs high-pressure gas which is allowed to expand through an orifice into a region of lower pressure, the cold expanded gas then being utilized as a refrigerant. Such cooling action, called the Joule-Thompson effect after its discoverers, has been utilized commercially by Hampson, Linde, and others in the liquefaction of air and other gases. While extremely low temperatures are obtained by these systems, lower than —220 deg. F. in the case of liquefying air, the efficiency of the process is of the order of 8 per cent.

Some experimental data are available for the free expansion of air. These experiments show that the drop in temperature due to the free expansion depends on the initial temperature of the air, being greatest for the lower initial temperatures, as shown in the following table for expansions of 1 atm.

Initial Air Temperature, Deg. F.	Temperature Drop, Deg. F.
200	0.34
125	0.40
60	0.46
0	0.57
−50	0.69
−100	0.85
−150	1.15

The temperature drop due to free expansion will, of course, vary with the different gases, bearing some direct relation to the ratio of their specific heats. Assuming this generalization to be true, the temperature decreases to be expected when expanding saturated hydrocarbon vapors will be less than those given above for air, since the ratio of specific heats for hydrocarbons is less than that for air.

These statements regarding free expansion are made with the reservation that the gases are dry and do not carry entrained liquid particles. The release of pressure on any such liquid particles will cause a considerable decrease in temperature due to their vaporization under the reduced pressure conditions. In a case at hand, measurements were made upon a stabilizer overhead vapor which consisted principally of propane. This vapor had an initial temperature of 104 deg. F. and was expanded from 155 to 25 lb. per sq. in. absolute, or through a range of 8.6 atmospheres. The results showed a decrease in temperature of 1.85 deg. F. per atmosphere of expansion. By taking some precautions to rid the vapor of entrained liquid particles ahead of the expansion valve, a temperature drop of only 0.33

deg. F. was obtained for the same operating conditions. In fact, we may attribute the general erroneous belief that free expansion results in an appreciable reduction in temperature to the fact that the gases are not dry and saturated, and to the inaccurate readings of the jet temperatures.

For the sake of emphasis let it be assumed that we have available for expansion a gas similar to the stabilizer overhead previously mentioned. Further, let us assume that this gas is essentially all propane and that it will be expanded from an initial pressure of 187 lb. absolute to a final pressure of 20 lb. What will be the temperature of the gas after expansion, providing it is free from liquid entrainment? With an initial temperature of 110 deg. F. it will be justifiable to use the coefficient experimentally determined, namely, 0.33, because of the absence of data on the subject in literature covering properties of hydrocarbons. On this basis the drop in temperature will be (187 — 20) 0.33/15 or 3.67 deg. F., giving a final temperature of 106.3 deg. F. Now, taking the specific heat of propane as 0.0255 B.t.u. per cu. ft., the maximum possible cooling effect to be derived from the expansion of 1,000 cu. ft. of this vapor will be $1{,}000 \times 0.0255 \times 3.67 = 93.6$ B.t.u. Such a small refrigerating effect should once and for all permit us to eliminate the free expansion method from further serious consideration as a possible refrigerating means.

Adiabatic expansion offers a better means. We all are familiar with the heating effect taking place when air is compressed in a compressor, but we seldom stop to realize that by reversing this cycle it is possible to produce a refrigerant. This naturally follows since heat and mechanical energy are mutually convertible. Thus, if a compressed gas is allowed to expand in a cylinder by moving a piston, resulting in the performance of external work, the work so performed is produced at the expense of the heat contained in the working substance. Assuming that the expansion takes place in a non-conducting cylinder, the expansion is adiabatic, and the resulting cold exhaust gas is available for circulation in a heat exchanger as a refrigerating medium.

Claude originally used this principle with great success for liquefying air by compression, cooling and expansion of the air itself. Commercial refrigerating apparatus operating in this fashion, however, is represented by a relatively small number of installations, and these are principally for the preservation of food supplies on shipboard. Apparently the only reason existing for the use of cold-air machines is the harmless character of the refrigerating medium employed, as the operating efficiencies are extremely low. This latter follows from the low specific heat value for air, which necessitates circulation of comparatively large volumes, requiring the use of bulky machinery. In practically all instances the machines are operated on a closed circuit where the same air is recirculated over and over for the purpose of keeping the working temperature range as low as possible. At the same time this method obviates the attendant loss and practical operating difficulties encountered by the freezing of the moisture carried by outside air when taken into the system.

This same general method, employing natural gas as the expanding medium, has been used in connection with the manufacture of natural gasoline by the compression process. For the purpose of establishing a basis of comparison between this method and the one already discussed, involving only the free expansion of a gas, we are forced to assume the operation of an expansion engine under identical conditions. As will be recalled, we have dry, saturated propane vapor available at a pressure of 187 lb. absolute and a temperature of 110 deg. F. This gas can be expanded to a final pressure of 20 lb., at which point the temperature is desired.

Further, let us assume that we will allow the expansion to take place in an ordinary type of reciprocating machine and that the gas will be forced to perform work during the expansion. A sufficient load for this purpose may be acquired by driving a water pump. For these conditions we find the temperature of exhaust, or that corresponding to the pressure of the gas after expansion, to be

$$570 \left(\frac{20}{187}\right)^{\frac{1.153-1}{1.153}} = -33.8 \text{ deg. F.}$$

Using this cold gas as a refrigerant, the available cooling effect from the expansion of 1,000 cu.ft. of the propane vapor is $1{,}000 \times 0.0451 \times 110 - (-33.8) =$ 6,480 B.t.u. It should now be apparent that the expander method results in a refrigerating effect over 62 times greater than that obtainable were the gas allowed to expand freely through the same pressure range, as described above.

While it is recognized that the expander method produces a refrigerant of greater intensity than that obtainable by free-expansion means, it is necessary to call attention to certain obvious disadvantages which it possesses. As has been previously stated, the refrigerant produced is a very cold and dry gas. The removal of heat by such a medium necessitates that the thermal transfer be made entirely by conduction, or from the hot medium to the metallic transfer surface, and from this surface to the cold gas. In practically all cases the hot medium to be refrigerated is a liquid, which means that the greatest resistance to the flow of heat will be upon the refrigerant or gas side. This naturally follows from the fact that the heat transfer coefficients for gases are materially lower than for liquids, a fact which can be attributed to the lower specific heat of gases as contrasted to liquids and their molecular arrangement. We must, therefore, conclude that the use of a refrigerant in the gas phase places an initial handicap upon the method because of the lower thermal efficiency of the exchange equipment. This necessitates the handling of large volumes of the refrigerant for a given refrigeration duty, and this refrigerant, furthermore, must be dry.

Low operating temperatures also mean additional lubricating problems. Today there are available well-designed and efficient steam turbines which make ideal expansion units as compared to the ordinary reciprocating machines. This type of expander solves the lubricating difficulties since no internal oiling is required by the turbine.

Another objection to the use of the expansion method is the necessity of operating with a large expansion ratio and initially cold gas if a reasonable efficiency is to be obtained. Inasmuch as the recovered power from an expander unit is always only a fraction of the energy required to compress the expanded gas back to the

initial pressure, it is evident that such a procedure will likewise be difficult to justify. From this it may be concluded that the expander system is practically limited to the rare case where high pressure vapor exists and where this gas can be economically disposed of without recompression after utilizing it as a refrigerant.

Refrigeration by Evaporation of Volatile Liquids

The most common methods of refrigeration are those used in the ice and cold-storage business. These processes all utilize the heat-absorbing properties of vaporizing liquids, which phenomena may readily be understood by the familiar example of boiling water.

When water is boiled by means of the heat from a flame, it is generally thought of as heating process from the standpoint of water. It may be regarded, however, as a cooling process with respect to the fire. The hot products of combustion, passing around the vessel of boiling water, are cooled. If another liquid boiling at a lower temperature is used in the vessel, a fire may not be necessary to cause boiling, as the heat in surrounding objects may be sufficient to cause the boiling. This is especially true if the boiling point is very low, as with anhydrous ammonia which has a boiling point of — 28 deg. F. If this liquid is placed in an open dish it will absorb heat from surrounding objects and the atmosphere and boil violently. The outside of the vessel will become heavily frosted by moisture condensed from the air as a result of the low temperature of the vessel walls.

The temperature at which each liquid boils varies with the pressure, an increase in pressure raising the boiling point and a decrease in pressure lowering it. Due to this fact a refrigerant can be made to boil at any desired temperature by placing it in a receptacle where the required pressure can be maintained. If, for example, ammonia is used, and a certain temperature is desired above its normal boiling point of — 28 deg. F., it is only necessary to keep the pressure sufficiently above atmospheric pressure to obtain the desired higher boiling point.

In order more clearly to set forth the refrigerating effect obtainable from the evaporation of a volatile fluid, consider what could be accomplished by the volatilization of liquid propane. Let us return to the previous example and liquefy the 1,000 cu. ft. of propane vapor available at 187 lb. absolute. To do this, it is only necessary to cool the vapor from its initial temperature of 110 deg. F. to the liquefying point, or to 100 deg. F. We can assume, however, that facilities are at hand which will permit cooling the propane vapor to a temperature somewhat lower than the liquefying point, say, to a temperature of 85 deg. F. This will result in a liquid propane condensate having this same temperature.

In the two previous examples the expansion range for the refrigerant vapor was from 187 to 20 lb., so that for purposes of comparison, we shall expand the liquid propane of the present example through the same range, or to a final pressure of 20 lb. This is the same as saying that we shall allow evaporation to take place at 20 lb. per sq. in. absolute. The temperature of the boiling propane under this condition will be —30 deg. F., but the amount of cooling developed will depend on the specific and latent heats of the propane under the evaporating conditions. This cooling effect equals $L - (H_1 - H_2)$ where L is the latent heat at 20 lb. absolute, H_1 is the heat of the liquid at 85 deg. F. and H_2 is the heat of the liquid at 20 lb. absolute. Hence, cooling effect = 179 — 50.5 — (— 16) = 112.5 B.t.u. per pound of propane. Inasmuch as our original 1,000 cu.ft. of propane vapor is equivalent to 1,000 × 0.1162 or 116.2 lb. of liquid propane, the total B.t.u.'s absorbed will be 112.5 × 116.2 or 13,100 B.t.u.

Recalling the previous examples, it will be remembered that for the case of free expansion of 1,000 cu. ft. of propane vapor from 187 to 20 lb. absolute, a refrigerating effect equal to 93.6 B.t.u. was obtained. For the second case, or where the same quantity of propane vapor was expanded through the same pressure range, but through an expander engine, the refrigerating effect increased to a value of 6,480 B.t.u. For the present case, where the liquefied propane vapor was expanded under identical pressure conditions, a refrigerating effect of 13,100 B.t.u. was developed. We can, therefore, conclude that the evaporation of liquid propane resulted in a refrigerating effect of over 140 times that obtainable with the same amount of propane vapor expanding freely in the gaseous phase through the same pressure range. Likewise, the evaporation of liquid propane resulted in a refrigerating effect of over twice that obtainable from the expansion of the same quantity of propane vapor through an expander operating under identical pressure conditions. Since a greater refrigerating effect is obtained from a substance when it is permitted to vaporize from the liquid phase, practically all modern mechanical refrigerating processes are now based on this principle.

Although the direct act of refrigeration by a vaporized liquid is completed when the liquid has been evaporated, the continuation of the process at a reasonable cost demands that the vapor be collected and reconverted to a liquid so that it can be used repeatedly. For this purpose there are two chief methods, the absorption system, ordinarily used only with ammonia, and the compression system, which is applicable to any vapor.

Absorption System

The absorption system (except for those modifications employing the *adsorptive* effect of solids such as activated carbon) is based on the high solubility of ammonia in water, which at 50 deg. F. will absorb 900 parts of ammonia gas per volume, while at 100 deg. F., it will take up only slightly over one-half of this quantity. Briefly, the process consists in allowing ammonia liquid to evaporate in pipes or refrigerating coils at low pressure, thus removing heat from the substance refrigerated. The vaporized ammonia then passes to an absorber where it is absorbed in water maintained at a low temperature.

The resulting charged water is pumped from the absorber into a generator, or still, where ammonia vapor is driven off. This evaporation is effected under a considerable pressure by the application of heat in the form of steam in closed coils. By subsequent cooling of the vapor so evaporated, a liquid ammonia product is available at essentially the pressure carried in the still. This refrigerant is then allowed to flow through a control or expansion valve into the refrigerating coils

where vaporization again takes place through the absorption of heat from the surroundings. The water recovered from the base of the still passes through a system of heat exchangers and coolers and returns to the absorber for recharging with ammonia vapor from the cooling coils.

The equipment and operation of an absorption refrigerating plant is generally much more complex than indicated by the foregoing description. It is apparent that with this system the water absorbs or dissolves the ammonia vapor from the evaporator at low temperature and pressure, and then is made to give up or distill off the absorbed ammonia as a vapor at a much higher temperature and pressure. A difference of 8-10 per cent in the strength of the strong and weak liquor will produce economical operation of the system under ordinary conditions. The change in pressure level is brought about by a mechanically operated pump which increases the pressure of the system from that of the absorber to that of the still and condenser and is, therefore, the only piece of moving machinery required by this method. The ammonia vapor from the still must, of course, be generated at such a rate that the pressure in the condenser will be sufficiently high entirely to liquefy the vapor with the available cooling water.

Compression System

The compression system of producing refrigeration is analogous to the absorption in that it comprises two main portions, a high-pressure or warm side, and a low-pressure or cold side. The difference between the two systems lies in the means employed for creating the necessary pressure differential. In the case of absorption this difference is brought about by taking advantage of the vapor pressure phenomenon and applying heat to the refrigerant at the proper point in the cycle. In the case of compression the pressure differential is overcome solely by mechanical means or by the compression of the low-pressure refrigerant vapor to the required higher pressure. Although ammonia, on account of its high heat of vaporization and low working pressure, is the refrigerant most generally used in the compression method, any number of other agents are employed to fit specific commercial requirements. Except for the differences introduced in operating pressures and temperatures, the vapor compression systems are very similar, regardless of the refrigerating medium used.

The compression system depends upon the compression, either by jet or mechanical means, of the vapor employed to a point sufficiently high that it may be liquefied by the removal of its heat content with ordinary temperature cooling water. The liquefied medium is then allowed to revaporize, the necessary heat for this purpose coming from the object to be cooled, and the resulting vapors returned to the compressor for repressuring.

In the mechanical compression system, as in the case of the absorption method, the liquid refrigerant flows from the accumulator to the expansion valve, the opening of which can readily be controlled to any desired size. In passing this valve the pressure upon the liquid is reduced, for example, from 187 to 20 lb., the latter pressure being that of the evaporator. The evaporator pressure is maintained constant at 20 lb. by the action of the suction side of the compressor. Such reduction in pressure through the valve immediately causes partial vaporization of the liquid refrigerant, but, since it takes appreciable time to supply to each pound of liquid passing the valve the required heat of vaporization, the vaporization is by no means instantaneously completed as is so often supposed. For this reason the greatest portion of the refrigerant arrives in the evaporator at a temperature corresponding to the pressure maintained therein. This liquid in the evaporator now absorbs heat from the refrigerator, or from whatever is to be cooled, causing boiling, the vaporized refrigerant being recovered continuously in the gas phase by the compressor.

Jet Compression System

Commercial development of the compression method involving the use of ejectors has been retarded until recently because of the inefficiency of this type of apparatus. Now such units are capable of handling very large volumes of low density vapor, and as a result, have given impetus to the use of water as a refrigerant. In fact, this method must now be given serious consideration wherever moderate temperatures, as from 40 to 60 deg. F., and sufficient steam and cooling water are available. The method is, therefore, particularly adapted to air conditioning and numerous other processes about industrial and chemical plants.

This method of jet refrigeration consists in boiling off water vapor at low pressure and compressing it by the ejector action of a steam jet. The jet discharges the water vapor at a high enough pressure to permit of condensation by water of ordinary temperature. Although it would be physically possible to compress these vapors to atmospheric pressure, it is not necessary to do so since steam will readily condense around 2 in. absolute pressure. As a result, the entire system operates under a high vacuum, for which reason it is often referred to as the vacuum refrigerating system.

Such a system consists essentially of an evaporator connected to a condenser by means of a steam-jet booster. The water to be cooled is sprayed into the evaporator where a small amount of it is immediately flashed to steam under the vacuum conditions. The amount flashed absorbs its heat of vaporization from the remaining water, chilling the latter to a temperature corresponding to the vacuum maintained. The chilled water is withdrawn from the evaporator and pumped to the point where it is to be used, after which it is returned for re-chilling. Evaporation loss is replaced by make-up water supplied from an outside source or by the return of condensate from the main condenser. Vacuum is maintained in the evaporator by the steam-jet booster and condenser with auxiliary air pump. The mixture of water vapor and propelling steam is condensed, and the resulting condensate handled in the conventional manner.

The popularity of steam-jet refrigeration rests primarily on the advantage of direct evaporation without a chemical, on simplicity, low upkeep cost, and absence of moving parts. However, the proper selection of a suitable system for any refrigeration project requires careful study of all of the various phases involved.

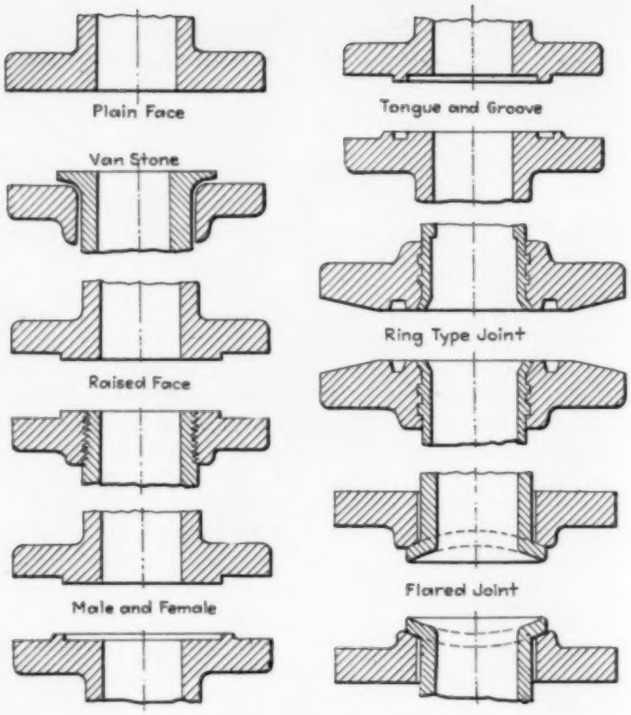

Fig. 1—Seven types of flanged joint most commonly used in chemical industry

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Choosing Gaskets For Use in Chemical Plants

MANUFACTURING PLANTS handling chemicals and other materials, of which there are many kinds that use a large number of types of equipment and operate under widely diverse conditions of pressure, temperature, etc., offer a large variety of uses for materials effectually to seal joints against leakage of liquids and vapors. While it is always important to eliminate leakage and its resultant waste, it is particularly necessary in apparatus handling chemicals as a safety precaution.

In every flanged joint there are three essential elements—the flanges, the bolts and the gasket. Of these, the gasket is of greatest importance to the maintenance engineer for the reason that it is the part to be renewed from time to time, the flanges and bolts usually being a fixed or permanent part of the installation.

First among these elements is the flange, which serves two purposes. It provides a means of connecting and disconnecting the joints, and serves as a seat for the gasket. The flange is either fastened to the pipe or vessel by means of screw threads, by expanding, by welding or by a combination of the latter two; it may be integral with the container wall as a result of casting or forging; or it may support a turned-over portion of the container wall.

There are several types of flange joint in general use. Those usually to be found in chemical plants appear in Fig. 1. The plain-face flange, shown at the upper left, is the earliest form and is still commonly used for moderate conditions such as pressures less than 150 lb. per sq.in. gage and 250 deg. C. temperature. Raised-face, Van Stone and male-and-female flanges are all similar in principle and now extensively used for pressures up to 1,500 lb. and 375 deg. C. temperature. They are not generally used for pressures below 150 lb.

The tongue-and-groove joint (Fig. 1, upper right) is generally used for pressures of 150 to 600 lb. per sq.in. gage and temperatures up to 375 deg. C. Ring and flared flanges are used for special conditions and comparatively high pressures and temperatures.

Each kind of flange has its own shape of gasket seat. For the plain-face, the entire flange face may be the gasket seat. The gasket may be "full face" and cover the entire flange face or it may be the ring type, covering only that portion of the flange face within the bolt circle. In either case, the necessary gasket pressure can be obtained, but it is more readily obtained if the ring-type gasket is used. However, the full-face type of gasket has the advantage of being more easily installed and centered, since it must be made to fit the bolt circle as well as the flange. It also serves to prevent broken flanges by careless overtightening of the bolts.

The ring-type gasket should be used exclusively for the raised-face, the Van Stone or lap, and the male-and-female joint. For each of these types, the present standards require that the gasket seat shall be of the same dimensions, with the exception that the annular space of the female flange is about $\frac{1}{16}$ in. larger in diameter to provide clearance.

The gasket seat for the tongue-and-groove joint is a

narrow space of the male-and-female type. A narrow ring-type gasket is used. The gasket is totally inclosed and for this reason must fit accurately in order to obtain the maximum effect. This type of joint, in addition to requiring accurate fit of the gasket, also requires accurate pairing of the two flanges and careful alignment. Being fully inclosed, the narrow gasket permits application of high gasket pressure without undue strain.

The gasket seat for the ring-type joint consists of narrow recesses in both halves of the flange and takes a special gasket generally oval in cross section. As with the tongue-and-groove joint this type also requires accurate fit of the gasket and of the flanges. The thickness of the gasket cross section precludes the use of heavy gasket pressures if the gasket is to be retained in the gasket space.

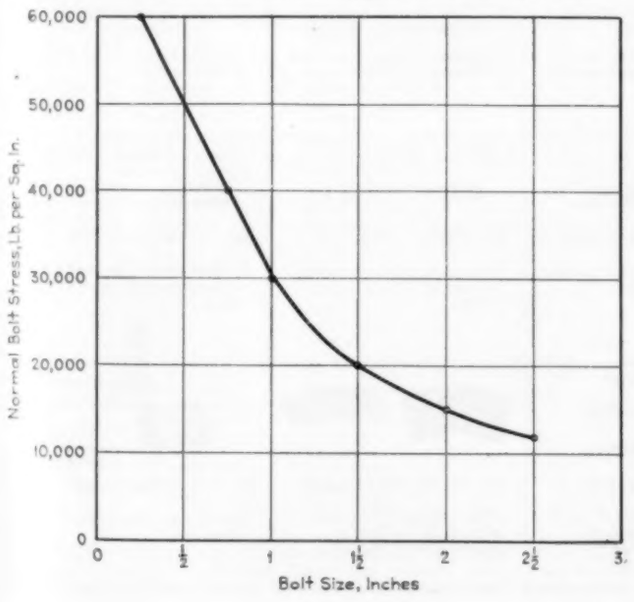
The gasket seat for the flared joint consists of opposite surfaces slightly concave with respect to each other, thus providing for slight misalignment of the piping, or warpage due to temperature changes. A special gasket in the form of a lens-shaped ring is the type required for this joint.

In addition to the shape, consideration must also be given to the finish of the gasket seat. In all cases, except with the flared joint, the gasket face of the flange should be exactly 90 deg. to the direction of the flow. For pressures below 150 lb. per sq.in., regular machine finish of the gasket face will usually suffice. For pressures of 150 lb. and over, the flange faces should be grooved or serrated. A continuous groove about $\frac{1}{64}$ in. in depth and at the rate of about 32 grooves per in. of width will prove satisfactory for most gaskets. For the flared joint and for metal-to-metal joints without gaskets, a perfectly smooth face is required.

Unit Pressure and Bolt Load

Many manufacturers and users of gaskets consider that the unit pressure on a gasket (gasket compression) should be at least ten times the intended working pressure in the lines or other equipment. Such a factor of safety is not excessive, particularly from an economic standpoint and is, therefore, recommended to chemical engineers. The pressure which constitutes the bolt load is, of course, the sum of the initial load (due to the tightening of the bolt), the external load (due to the fluid pressure in the line), and such intangible and incalculable items as the bending moments (expansion and contraction of pipes) and sudden large loads (impact of vibration), etc.

Fig. 2—Normal initial stresses for bolts of various sizes



Inasmuch as the initial load on a bolt is dependent on the skill of the workman, and since in many cases the pipe-fitter is either unskilled or careless, it is useless to attempt to calculate an initial bolt load. The only method of determining the true initial stress is actually to measure the elongation of the bolt or stud. In practice, it is considered to be entirely satisfactory to calculate approximately the maximum stress to which a bolt or stud is likely to be subjected by the formula (for iron), $t = 30{,}000/d$, where t is the unit tensile bolt stress (lb. per sq.in.) and d is the bolt diameter (in.). Fig. 2 shows values of the normal initial bolt stress as a function of the bolt diameter.

The resultant load on bolts may be calculated by a method involving the ratio of the yield of the connected members to the yield of the bolts. Since the conservative assumption is that the connected members are absolutely rigid and the bolts alone are elastic, the resultant bolt load is either the initial load alone, or the external load alone, whichever is the greater. These are extreme cases and in practice every case will lie between these two limits; and the resultant load on a bolt will vary between the sum of the initial and external loads as a maximum, and the greater of these two loads as a minimum.

The following rules are in use by many gasket manufacturers and by many design engineers:

1. If a bolt is much more elastic than the connected members, design it for the initial load, or for the external load, whichever is the greater.
2. If the probable yield of the bolt varies from one-half to that of the connected members, calculate the resultant load equal to the initial load plus from one-fourth to one-half the external load.
3. If the yield of the connected members is four or five times that of the bolts, calculate the resultant load as the initial load plus about three-fourths the external load.
4. If there is an extreme relative yielding of the connected members, calculate the resultant load at nearly the sum of the initial and extreme loads.

Example — What is the desired diameter of studs for a steam cylinder 16 in. in diameter, operating on steam at 125 lb., with the cylinder head secured by 14 studs when using a steel-asbestos gasket?

Solution — Conditions in Rule (3) are approximated. The initial load, W_1, is assumed to be twice the external load, W_2. Therefore,

$$W_1 = 2W_2 = \frac{2 \times (16)^2 \times 3.1416 \times 125}{4 \times 14} = 3{,}600 \text{ lb. per sq. in.}$$

and, from Rule (3), $W = W_1 + 0.75\,W_2 = 4{,}950$ lb. per sq. in.

Hence, $\frac{(d_1)^2 \times 3.1416 \times 7{,}000}{4} = 4{,}950$

or, $d_1 = 0.95$ in. at the root of thread. Therefore, the desired stud diameter = $1\frac{1}{8}$ in. From the graph of Fig. 2, the probable maximum bolt stress is about 27,000 lb. per sq. in.

Proportions of Gasket — Total bolt load = $14 \times 4{,}950 = 69{,}400$ lb. per sq. in. Gasket pressure is, say, $10 \times 125 = 1{,}250$ lb. per sq. in. As a *tentative* figure, $69{,}400/1{,}250 = 55.5$ sq. in. of gasket area is estimated. Since the counterbore of the cylinder is $16\frac{1}{8}$ in. in diameter, and $16.125 \times 3.1416 = 50.66$ in., we see that the gasket width should be about 1 in. By calculation, we

find that a gasket of ¾ in. width, giving a gasket of 16½ in. I.D. and 17¾ in. O.D., will give a ratio of gasket pressure to line pressure of 1,480/125 = 11.8, which is satisfactory.

The type of gasket frequently used for this service is the flat, unconfined type. Totally confined gaskets are usually subjected to greater unit pressure, that is, such gaskets are usually narrower. A rule of 16 times the working pressure is frequently used for confined gaskets but in this case care must be taken to see that the gasket pressure is below the elastic limit of the flange material. The above calculations are based on temperatures not exceeding 750 deg. F., since, for higher temperatures, provision must be made for creep stress.

Worthington ("Chemical Engineers' Handbook," p. 1789, McGraw-Hill, 1934) gives the following method of calculation of gasket widths:

"The following method of calculating gasket widths for unconfined copper gaskets is due to Ernst et al, "A Direct Synthetic Ammonia Plant," *Ind. Eng. Chem.*, Vol. 17, 1925, p. 775):

$$\text{Width} = \left(\frac{2.5\,Pt}{2F} + \frac{PD}{4}\right)\frac{1}{60{,}000}\ \text{in.}$$

where P = internal pressure, lb. per sq. in.,
t = gasket thickness, in.,
F = coefficient of friction for sliding, 1.5 to 2.0, and
D = inside diameter of gasket, in.

Let A = gasket area, sq. in. (*i.e.*, area of gasket annulus)
N = number of bolts.
Then 60,000 A/N is the load per bolt, which must not exceed a safe value for the strength of the bolt nor for the intensity of shearing stress at the root of the bolt threads."

Gaskets and Gasket Materials

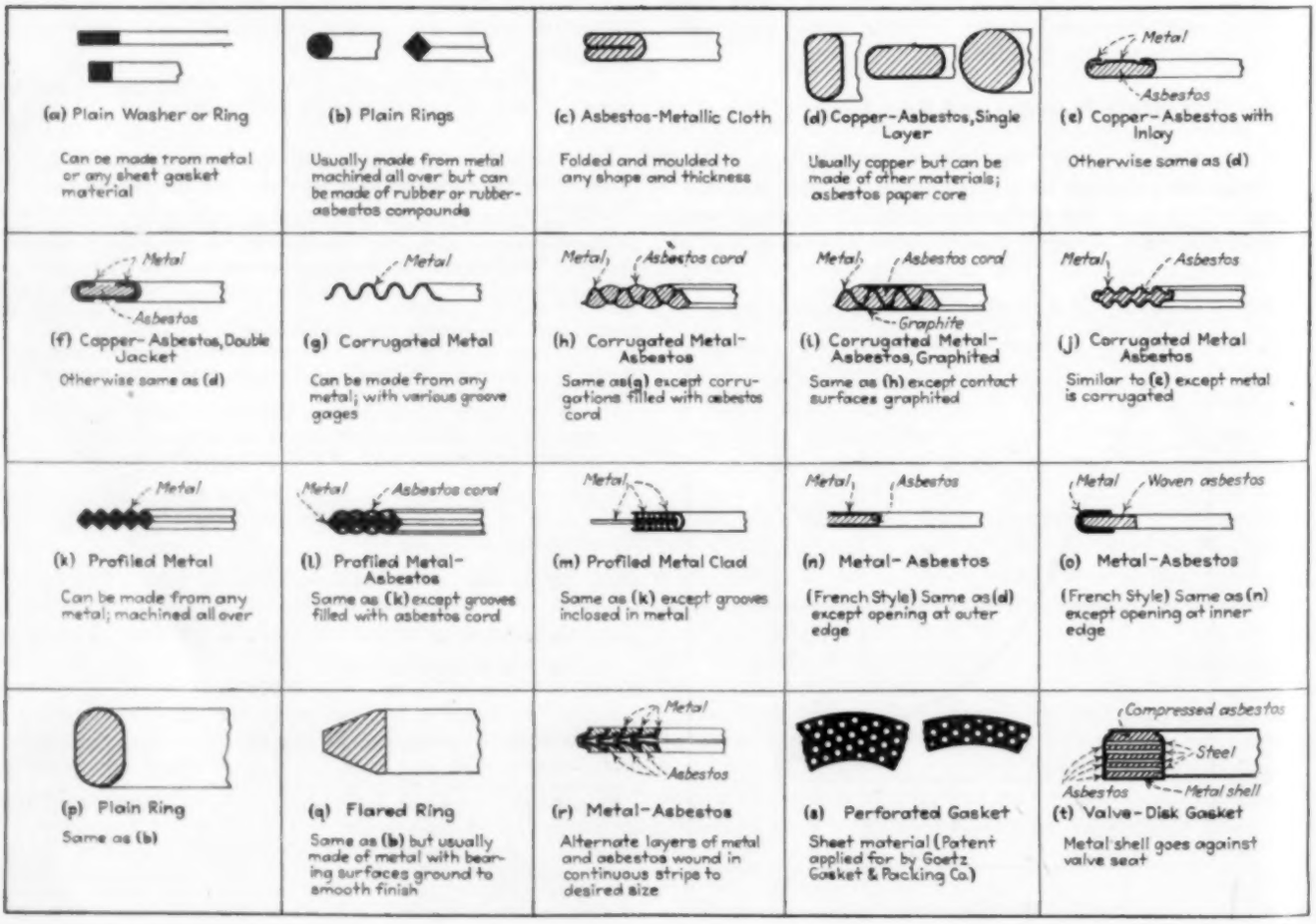
As stated before, gaskets must frequently be replaced and, many times, much oftener than should be necessary if the proper precautions were taken. Partly because of the relative cheapness of a gasket, and partly through carelessness or ignorance, little attention is paid by most plant managements to the true cost of gaskets, and no attempt is made to keep accurate records of total gasket costs to a process. Such true costs should, of course, include the initial cost of the gasket, the labor-hours necessary for renewals, and the process hours lost due to gasket failure. It is no exaggeration to say that thousands of dollars and thousands of unnecessary hours of shut-downs and installation labor may be saved in a large chemical plant each year with more care in the selection and installation of gasket materials.

In addition to gaskets made by cutting rings or washers from sheet material, there are a large number of different types of formed and sized gaskets available for purchase. A number of these are shown in Fig. 3.

When sheet gasket materials are used, there are at least three important considerations, including selection of the most suitable material, cutting of the gasket to the desired size and shape, and proper installation.

While it may not be possible to describe and codify completely all of the many sheet materials that are available for use as gaskets, for the commonly used materials such a code is entirely feasible. A code similar to that

Fig. 3—Twenty commonly used types of formed and sized commercial gaskets


(a) Plain Washer or Ring
Can be made from metal or any sheet gasket material
(b) Plain Rings
Usually made from metal machined all over but can be made of rubber or rubber-asbestos compounds
(c) Asbestos-Metallic Cloth
Folded and moulded to any shape and thickness
(d) Copper-Asbestos, Single Layer
Usually copper but can be made of other materials; asbestos paper core
Metal
Asbestos
(e) Copper-Asbestos with Inlay
Otherwise same as (d)
Metal
Asbestos
(f) Copper-Asbestos, Double Jacket
Otherwise same as (d)
Metal
(g) Corrugated Metal
Can be made from any metal; with various groove gages
Metal
Asbestos cord
(h) Corrugated Metal-Asbestos
Same as (g) except corrugations filled with asbestos cord
Metal
Asbestos cord
Graphite
(i) Corrugated Metal-Asbestos, Graphited
Same as (h) except contact surfaces graphited
Metal
Asbestos
(j) Corrugated Metal Asbestos
Similar to (e) except metal is corrugated
Metal
(k) Profiled Metal
Can be made from any metal; machined all over
Metal
Asbestos cord
(l) Profiled Metal-Asbestos
Same as (k) except grooves filled with asbestos cord
Metal
(m) Profiled Metal Clad
Same as (k) except grooves inclosed in metal
Metal
Asbestos
(n) Metal-Asbestos
(French Style) Same as (d) except opening at outer edge
Metal
Woven asbestos
(o) Metal-Asbestos
(French Style) Same as (n) except opening at inner edge
(p) Plain Ring
Same as (b)
(q) Flared Ring
Same as (b) but usually made of metal with bearing surfaces ground to smooth finish
Metal
Asbestos
(r) Metal-Asbestos
Alternate layers of metal and asbestos wound in continuous stripe to desired size
(s) Perforated Gasket
Sheet material (Patent applied for by Goetz Gasket & Packing Co.)
Compressed asbestos
Steel
Asbestos
Metal shell
(t) Valve-Disk Gasket
Metal shell goes against valve seat

suggested below can be made up by the maintenance engineer for the conditions encountered in his plant. Such a code, in addition to embracing identification numbers for the various materials should also include evaluation factors and uses for the usual available materials.

Sheet gasket material is usually purchased by the pound, but it is always used by the unit area. The weight per square foot will, therefore, determine the cost of a single gasket, where the basis for purchase is by the pound. The following tabulation shows the effect where the price per pound is identical and the weight per square foot varies within reasonable tolerance limits:

Source	A	B	C
Cost per lb.	$0.50	$0.50	$0.50
Weight, lb. per sq. ft.	0.40	0.55	0.70
Cost per sq. ft.	0.20	0.275	0.35

Assuming a normal thickness of $\frac{1}{16}$ in., a manufacturing variation of plus or minus 10 per cent will add or subtract this much to or from the cost per square foot. The variation may generally be expected to occur on the plus side and should be held to a maximum of 5 per cent on sheets $\frac{1}{16}$ in. thick or over. This tolerance is necessary to assist the manufacturer. Beyond this figure it is pure waste from the user's standpoint.

Actual data should be compiled for each type of gasket material and for each manufacturer's product. This will serve the following purposes: It will permit the purchase of the most economical gasket material of a particular type, and will enable the use of the most economical type when several types are equally as suitable for a given purpose. These data must be used with discretion because it may not always be true that the gasket material showing the lowest cost per unit area is the cheapest.

The choice of gasket materials for chemical plant use will be dictated not only by the pressure and temperature of the fluids to be handled, as for the relatively inert water and steam of power plant practice, but also by the particular nature of the fluids. It is for this reason that a wide variety of materials is required for gaskets in chemical plants. It will be necessary for the engineer to study each typical application, in the light of such general recommendations as can be made here, and to specify the use of a material according to a code number and to set up a specification for each class of material on which the purchasing agent can set up a list of equivalents and secure comparative prices. Such codes have been proposed, for example, by McGeary (*J. Am. Soc. Naval Engrs.*, Vol. 41, 1929, pp. 563-88), who also gives a typical set of recommendations for gasket materials (and pump packings) for naval and marine machinery. A reproduction of McGeary's code (as relates to gasket materials) is given, by permission, in an accompanying tabulation, with some additions by the present author. The types are divided according to the principal material of which each is composed. In the discussion below, materials will be discussed with reference to their field of application, with exceptions noted where necessary.

Gasket Applications

The most widely used sheet-gasket material is Code 150, compressed asbestos sheet. Some individual engineers of considerable practical experience have stated that, in their opinion and experience, this type is satisfactory for use in 70 to 80 per cent of all cases where a gasket is required. However, it is not the most suitable for use with ring-type flanges, or where a very narrow gasket may be used. In chemical plants, the single-ply sheet is to be preferred, as the cross-laminated sheet is likely to separate into its individual plies and cause blow-outs. Code 151 is more generally used with flanges which have become roughened or pitted from use. On large diameter joints, Code 153 can be used to reduce

Proposed Code for Gasket Materials

(After F. M. McGeary)

Code Number	Principal Material	Form
150	Asbestos	Compressed asbestos sheet
151	Asbestos	Asbestos-metallic cloth sheet
152	Asbestos	Asbestos-metallic cloth gasket
153	Asbestos	Asbestos-metallic cloth tape
154	Asbestos	Asbestos cloth
155	Asbestos	Asbestos paper
156	Asbestos	Asbestos rope
226	Vegetable fiber	Hard fiber sheet
227	Vegetable fiber	Chart paper, shellacked
290	Vegetable fiber	Plant fiber sheet
351	Rubber	Red rubber sheet, plain
352	Rubber	Black rubber sheet, plain
353	Rubber	Red rubber sheet, cloth insertion
354	Rubber	Black rubber sheet, cloth insertion
355	Rubber	Red rubber sheet, wire insertion
356	Rubber	Black rubber sheet, wire insertion
410	Metal and fabric	Copper-asbestos gasket, inclosed
411	Metal and fabric	Monel-asbestos gasket, inclosed
412	Metal and fabric	Steel-asbestos gasket, inclosed
413	Metal and fabric	Copper-cork-asbestos gasket, inclosed
420	Metal and fabric	Copper-asbestos gasket corrugated
421	Metal and fabric	Monel-asbestos gasket corrugated
422	Metal and fabric	Steel-asbestos gasket corrugated
423	Metal and fabric	Steel-asbestos gasket corrugated inclosed
470	Metal	Soft iron sheet
471	Metal	Aluminum sheet
472	Metal	Copper sheet
473	Metal	Lead sheet
474	Metal	Monel sheet
475	Metal	Zinc sheet

Code 150, a compressed asbestos sheet, is made of a compound composed of asbestos fiber and rubber compound which has been thoroughly mixed and rolled or rolled and plied under pressure to the desired thickness. It is made in two distinct styles, single-ply or so-called homogeneous, and cross-laminated. The single-ply will not separate as sometimes happens with the cross-laminated but the latter has equal strength in all directions. It is made in several grades, the asbestos fiber content being the dominant factor. The highest grade will contain approximately 75 per cent by weight of asbestos fiber.

Code 151, an asbestos-metallic cloth, is made of wire-insertion woven asbestos cloth which has been treated with a rubber compound. About 50 per cent by weight is cloth. The asbestos yarn will contain from 5 to 23 per cent by weight of cotton, the better grades running from 5 to 10 per cent.

Code 152, an asbestos-metallic cloth gasket and **Code 153**, an asbestos-metallic cloth tape, are both manufactured from Code 151 materials.

Code 154, asbestos cloth, is a woven cloth similar to Code 151 but containing neither wire nor rubber. It may be plain or twill weave. The thickness is limited to about 3/32 in. maximum. It will be rarely used as a gasket material for pipe flanges but may be used on large flanges of apparatus.

Code 155, asbestos paper, is made of short asbestos fiber, filler and binder.

Code 156, asbestos rope, is made of twisted rovings of asbestos yarn, the cotton content of which will be 10 to 23 per cent.

Codes 226, 227 and **290** are all made from vegetable fibers containing cellulose, pulped and rolled into sheet form.

Codes 351 and **352** are made of rubber and mineral fillers compounded and rolled to the desired thickness.

Codes 353 and **354** are made of plies of rubber sheet between which is a reinforcement of cotton sheeting.

Codes 355 and **356** are similar to Codes 353 and 354 except that the reinforcement is wire-mesh cloth.

Codes 410 to 413 inclusive and **420 to 423** are illustrated and described in Fig. 3.

Codes 470 to 475 are sheet metals and, with the exception of lead and zinc, should be dead-soft annealed and of not less than 1/16 in. thick for gasket material to provide some measure of plastic flow when the bolt pressure is applied.

wastage from cutting sheets, but care must be taken when joining the ends to provide a good fit at these points. Asbestos rope, Code 156, has been successfully used on flanges of nitrators and sulphonators. For nitric acid service, this code made of blue African asbestos fiber instead of Canadian chrysotile, laid in corrugations on the flange face, has been found to be satisfactory, especially if impregnated with paraffin wax.

No attempt will be made in this paper to cover completely all conditions of pressure, temperature and confined materials for which gasket materials should be used. A few general conditions will be described as a guide to the maintenance engineer in preparing a chart for each condition he will have to meet.

In general, we have two main conditions, pressure and temperature, subdivided as follows:

Case	Upper Pressure Limit, Lb. per Sq. In.	Upper Temperature Limit, Deg. C.
(a)	150	60
(b)	250	150
(c)	300	150–250
(d)	300	250–375
(e)	over 300	over 375

For condition (*a*) to (*d*), temperature rather than pressure will be the deciding factor in the selection of the gasket material to be used. For condition (*a*) all of the gasket materials listed can be used, but more generally Codes 155, 227, 290, or 351 to 356, inclusive, will be used. For conditions (*b*) and (*c*), Codes 150 to 154, inclusive, 410 to 413, inclusive, and 420 to 423, inclusive, may be used, but Codes 150 to 154 will be more generally used. For condition (*d*) all the Codes recommended for conditions (*b*) and (*c*) may be used, but Codes 410 to 413, inclusive, and Codes 470, 471, 472 and 474 will be more extensively used. For condition (*e*), Codes 470, 471, 472 and 474 are to be preferred.

It is suggested that two charts be prepared by the maintenance engineer as a means of systematically using gasket materials. In one of these charts general conditions should be tabulated, while in the other, individual applications should be tabulated. For the first chart the following headings are suggested:

Service, such as gas, water, brine, steam, etc.
Pressure, maximum.
Temperature, maximum.
Code numbers recommended for individual service and conditions.
Manufacturers' brand name or identification number of satisfactory materials.

For the second chart, when this is considered desirable, the following headings are suggested:

Unit, such as piping.
Service, such as gas, water, steam, etc.
Location, such as inlet flange to pump, etc.
Code number used.
Manufacturers' identification of used material.

The careful selection of a gasket material is not alone sufficient. It is also necessary to use care in the making, handling and installation. Cutting offers a prolific source of carelessness. It may be poorly done, as, for example, incorrectly sized and shaped, with frayed edges and cracked surfaces. In the cutting, care is not always taken to lay the gasket out to get the most out of each sheet and the scraps are not always saved for use in making smaller gaskets. To reduce waste in cutting to a minimum, a gasket-cutting machine should be available, and its use placed in the charge of a small number of men whose duty it is to maintain a stock of such different sizes of cut gaskets as may be needed. If this is done, properly cut gaskets are always available, the economic use of gasket sheets and trimmings can be obtained, and a marked saving in material cost, lost process hours, and labor cost of installation will result, more than offsetting the cost and operation of the machine. Cutting of gaskets by hand, either with scissors or especially with a knife should be countenanced only in an emergency. Small gaskets can be produced in a satisfactory manner with a set of punches, but these must be kept sharp and in good condition.

Sheet-gasket materials which are made of asbestos and rubber, or entirely of rubber, should be carried in stock in moderate quantities, since they deteriorate with age. The ideal condition would be a dark room with a uniform temperature not exceeding 70 deg. F. As such a storeroom is not always available, conditions approaching it as nearly as practicable will be found to be worth while in preventing deterioration.

Installation of Gaskets

McGeary (*loc. cit.*) gives succinctly the most important precautions to be observed in the installation of gaskets: "For flange fittings, the thinnest [gasket] that can be used should be the rule. This will be governed by the alignment, the condition of the flanges and the distance between flanges. Both flange faces should be carefully cleaned of any foreign substance by scraping if necessary. The gasket should also be clean and should be installed without shellac, white lead, or similar material. (However, in many cases in chemical plant work, the use of graphite as a gasket coating is recommended; other lubricants, or coatings, are also profitably used in special cases in the opinion of many chemical engineers—J. H. P.) Tighten all bolts gradually and in order, applying pressure equally over the entire flange. Bolts should not be drawn down tight until the third circuit of the flange. Go over the bolts again after the line is in service. If there is continued gasket trouble with any pair of flanges, look for a warped flange or a groove." McGeary (*loc. cit.*) also cautions against the use of excessive pressure on an impregnated gasket and points out that such excessive pressure is apt to extrude the impregnant from the matrix of the gasket.

It should not be necessary, although chemical engineers often find need to recall the warning as to the laxity of pipefitters in cutting gaskets with openings smaller than the pipe; and/or their failure to center the gasket properly. In tongue-and-groove joints, a slight oversize will cause leaks. If the wrong gasket material is handy, pipefitters are likely to use it instead of asking for the one specified. Many of the difficulties can be minimized by maintaining a stock of machine-cut gaskets of a few established code materials, as recommended in this article.

Acknowledgment is made to the various manufacturers of gaskets and packings who furnished material used in the preparation of this paper. Further acknowledgment is due to Messrs. A. W. Limont, T. H. Chilton and F. M. McGeary for their reading of the manuscript and their suggestions for improvements, many of which have been incorporated.

Skillful Operating Technique Required to Make PERFUMERS' SYNTHETICS

By R. TRUBEK
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East Rutherford, N. J.

MANUFACTURE of synthetic chemicals for perfumery, an art which had reached a high degree of perfection in Europe, had been sadly neglected in this country up to 15 or 20 yr. ago. Scattered about the country were chemical companies which, more or less as a sideline, were making a few chemicals for this industry, but the majority of the hundreds of synthetic products required for the successful formulation of commercial perfumes were being imported, chiefly from Germany, France, Switzerland, and Holland.

Numerous factors were responsible for the delay in founding this industry in the United States; principal among these was probably the fact that this is an industry to which American methods of continuous, chemical engineering production cannot easily be applied. On the contrary, the manufacture of these chemicals, due to the comparatively small consumption, calls for batch production, with a continual re-cycling of equipment to produce other articles, in order to reduce the total investment required.

Skillful Manipulation Required

The manipulation of these synthetic products requires the services of unusually careful, well-trained operators. It is here that the American manufacturer found his greatest stumbling-block in competition with foreign synthetics, for our wage scale is so much higher than the European that, were it not for our tariff system, it would be practically impossible to produce a comprehensive line of "aromatics" in this country.

This recent addition to the American chemical group is, naturally affected by the general problems confronting the industry as a whole. Yet, like other groups, it has its own peculiar aspects, some of which will now be discussed.

A representative factory manufacturing synthetics for perfumery presents the greatest variety of raw materials, processes, and finished products. Unlike most manufacturers, who specialize in a certain type of chemicals, such as alcohols, esters, or hydrocarbons; or those who utilize fully the raw materials indigenous to their locality, the "aromatics" manufacturer produces chemicals which cover the entire chemical field, employing raw materials from practically all parts of the world.

Oxidations, reductions, sulphonations, esterifications, condensations, chlorinations, Friedel-Craft, Grignard, Canizzaro reactions; evaporation, crystallization, vacuum distillation—these are all routine procedure in the plant of the manufacturer of synthetic aromatics. Aldehydes, ketones, esters, alcohols, acids, hydrocarbons—all these, and more, are produced in these plants which continually seek the unusual.

The most unusual feature of the manufacture of these chemicals however is the technique incidental to their refinement. Chemical purity, as determined by the ordinary standards is, of course, essential. Yet in introducing certain chemicals in this field, of a purity exceeding that of those products which they seek to displace, many manufacturers have found to their great surprise that they have been unable to capture the market because somewhere in their process they have overlooked the fact that the product was being manufactured for an industry concerned only with "odor value." Competitive samples of chemicals currently used in the production of perfumes are often submitted by manufacturers in other lines who are anxious to enter this field. Many of these samples may be chemically pure in the accepted sense of the expression, and may yet have absolutely no value for the purpose for which they are intended, because they contain traces of impurities which cannot be determined by the methods usually employed.

Once a manufacturer has overcome his tendency to doubt the sanity of the average perfumer and has been convinced that his ordinary standards are useless in this field, his problem has just begun. Naturally, he is perfectly free to examine the products against which he wishes to compete, but he will find that capable operators and chemists who are also in possession of well-trained noses are few and far between. To distinguish between the nuances which occur in the various fractions of a distillation is an art which requires long and patient training in the manipulation of chemicals and oils to blend perfumes. While it is, of course, useless to indulge in generalities, yet the tradition of one of the oldest European aromatic houses, that it requires 12 years to "develop a nose," is not without foundation.

The mere determination of the unsuitability of the product is a small part of the battle. Factors which, in the ordinary routine of chemical manufacture seem insignificant, may become extremely important in the search for a "clean" odor. Sometimes, it is found that the metal

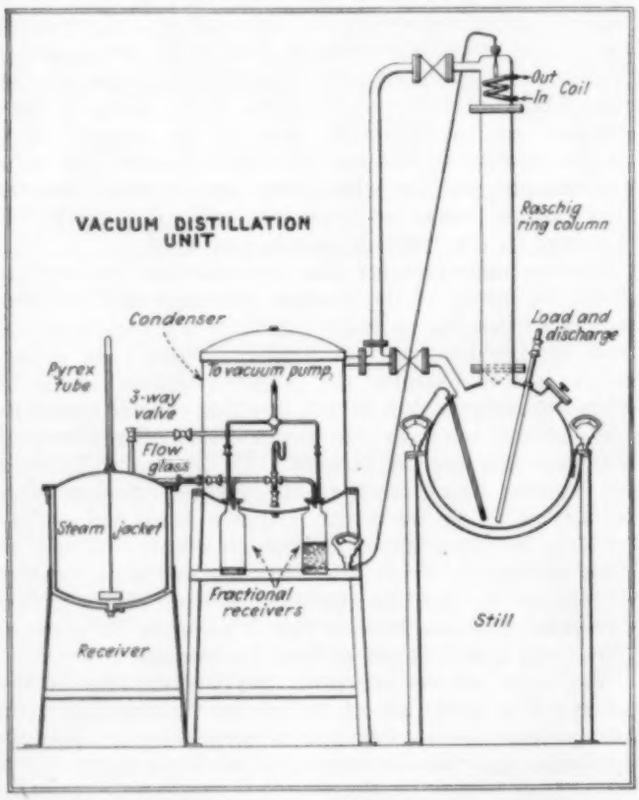
used in the construction of the apparatus in which the chemical is processed, although it may be perfectly suitable in regard to its ability to resist corrosion, imparts to the finished product a "note" which is practically impossible to remove and which renders it unfit for sale.

On the other hand, it is often found that the manufacture of a product can be successfully undertaken only from certain raw materials, regardless of the cost, merely because from these materials only can the impurities be successfully removed.

Vacuum Distillation Presents Problems

An extremely important factor in the manufacture of aromatics is the necessity of controlling vacuum distillation so that the final products will be free from that "burnt" odor so characteristic of the chemicals made by companies unfamiliar with the technique used in this field. The manufacturer must, of course, first equip himself with suitable apparatus, and must then embark on a system of training his employees in handling this equipment; elimination of leaks in a system with 2 to 3 mm. vacuum entails a great deal of patience combined with extensive experience with the whims of vacuum pumps and valves.

There is much inclination to scoff at the apparent necessity of this care regarding vacuum operation, but many of the synthetics used in perfumery are highly sensitive to heat; as the last 10 mm. of mercury often means a 50 deg. drop in temperature, it is well worth a little patience in locating a leak. Sometimes a mistake is made in coupling a large pump with a very small apparatus. As a result, a very good vacuum may be maintained, even if the system may have several minute leaks, as these are compensated for by the large capacity of the pump. This, however, makes for an unsuccessful distillation due to the fact that air, constantly being brought into contact with the boiling liquid through these leaks, causes oxidation which imparts a disagreeable "note" to the product.



To this end, it is extremely important to design the vacuum distillation equipment with the minimum of openings. Conventional type gage-glasses, flow-meters and otherwise desirable accessories must be dispensed with, if they present too many sources of trouble in securing and maintaining the necessary vacuum. Naturally one should have control of the distillation during its course, but the apparatus for doing so must be specially designed to present no opportunity for leaks, yet the whole still must be so constructed that it can readily be cleaned for the distillation of a different product.

If it be at all possible, the distillation kettles should be designed without bottom outlets, as these present an exceedingly annoying source of trouble. Unless one is absolutely essential, it is also best to dispense with the convential hand-holes on the still dome. The ideal system for vacuum distillation calls for loading the still by suction and emptying the residue by air pressure, thereby obviating the necessity of opening the still itself.

Thermometers, rather than being set into openings closed by corks, should have regular wells provided for them, so that any danger of air leaks at these points may be absolutely eliminated. Wherever possible, pipe joints should be welded; gasketed joints present difficulties because they must be given continuous attention to prevent leaks. Absorption of odors by the gasket material, which renders it much more difficult to clean the apparatus when another material is to be distilled, is also a disadvantage that should be avoided.

Naturally, the best designed equipment is worthless without the proper pumps. On the merits of the various types of vacuum pumps, one may argue endlessly. The choice, of course, should be influenced greatly by the materials to be distilled. The oil-sealed rotary type pumps are excellent for materials which do not volatilize and dilute the oil. Where such dilution occurs, the oil becomes worthless as a lubricant and the pump suffers undue wear. Piston-type vacuum pumps, on the other hand, have the decided advantage of being practically immune to this difficulty. Unfortunately, in our experience, we have found that American made piston pumps do not generally produce as high a vacuum as may be attained by some European makes.

The steam-jet pump which has been developed to a remarkable degree, is exceedingly satisfactory in a plant where large volumes of steam are available. This type of pump presents a minimum of wearing parts, is completely indifferent to volatilization of the distilling material, and can economically be built to produce a 3 to 4 mm. vacuum, with a tremendous evacuating capacity.

The accompanying sketch illustrates a few of the points to be emphasized in the construction of vacuum apparatus. The flow glass is so constructed that there is no strain whatever on the glass itself, and once made tight at the two joints, it will give very little difficulty from this score, yet it can be easily cleaned. The float arrangement eliminates the necessity of gage-glasses, which are extremely difficult to keep tight.

Naval Stores Developments

EDITORIAL STAFF REPORT

THE MOST PROMISING prospect for the naval stores industry lies in the direction of chemical development. Fifteen of the three hundred-odd papers presented at the St. Petersburg meeting of the American Chemical Society last month dealt with various phases of the economics and technology of this important chemical industry of the South.

E. L. Demmon of the U. S. Forest Service predicted that the A.A.A. marketing agreement now under consideration by the naval stores producers would raise the price the farmer will get for his gum. Under this agreement trees less than 9 in. in breast-height diameter should not be worked and not more than one face should be worked on any tree less than 14 in. in b.h.d.. It would also set up production quotas.

R. C. Palmer, chief chemist of the Newport Industries of Pensacola, whose articles on the technology of wood turpentine and rosin production appeared in *Chem. & Met.* in 1930, described recent chemical engineering developments in the steam and solvent process. Existing plants using this method require the cleaning of about 200,000 acres of cut-over pine forest land per year for full capacity operation. About 15 per cent of the turpentine and rosin made in the United States results from steam and solvent processes, in which approximately $15,000,000 is invested.

Processes involving the use of selective solvents or adsorption by fullers earth are employed at present for removing the relatively dark color from the natural wood rosin. The Newport company uses fullers earth in a contact process in cyclic operation. As compared with lubricating oil refining, a relatively higher ratio of earth to rosin is used. A 35 per cent solution of ethyl alcohol in petroleum naphtha is used to revivify the earth, which under normal operation may be re-used as many as 700 to 750 times.

Building Board From Extracted Wood

An interesting special product made from the extracted wood is an insulating and building board, known as Temlok, which is made in cooperation with Armstrong Cork & Insulation Co. The chips are screened, fibered to pulp and dried as board ¼ to ¾ in. thick.

McGlarvey Cline of the Wood Chemical Products Co. of Jacksonville described the distillation equipment of the industry, showing why it is essentially decentralized. At present the industry is composed of about 1,200 small pot stills scattered through the regions in which the crude oleoresins are produced. Centralized manufacture of gum naval stores is a dual problem: a technical problem of design and a problem of modifying the existing business customs and structure of the industry. So far all efforts to solve these problems have failed to demonstrate the over-all economy of centralized operations.

Papers on newly developed uses for naval stores products were presented by Pickett and Schantz of Hercules Powder Co. and older applications in paint and varnish, soap, and paper were reviewed by representatives of these industries.

Federal chemists have devised methods for storing turpentine to prevent rapid deterioration in quality, W. C. Smith and H. P. Holman, of the Bureau of Chemistry and Soils reported.

Under the usual conditions of storage, turpentine deteriorates rapidly as the result, principally, of the chemical action of oxygen absorbed from the air. Several years ago a firm manufacturing shoe polish had an opportunity to buy turpentine cheap. The bureau advised storage in air-tight metal tanks which had been prepared by shellacking the interior. The tanks were arranged so that water settling out of the turpentine could be drawn off frequently at the base. The tanks were kept completely filled excepting the space required for expansion. The turpentine stored in this way kept well for from 26 to 31 mo. At the end of this storage period some of the turpentine was stored in shellacked metal drums. Deterioration progressed somewhat, but most of the turpentine at the end of 4 yr. was in good marketable condition. Scientists think protection from air was the principal factor in preventing deterioration.

Laboratory scale experiments have also shown that it is possible to preserve turpentine by adding certain chemicals which counteract oxidization of the product. Powdered lime, sodium bisulphite, hydroquinone, and pyrogallol were effective.

Synthetic Camphor From Turpentine

One of the papers which attracted most attention was a description by Howard W. Elley and Ivan Gubelmann of du Pont's successful production of synthetic camphor from turpentine. Although made abroad for a number of years, it was not until 1916 that the du Pont company tackled the problem of its production in the United States. A plant was put into operation in 1919 and a considerable quantity was made in 1920 and 1921. Manufacture was discontinued, however, when the price of natural crude dropped from over $1 per lb. to $0.60.

With the acquisition of the Newport Chemical Corp. in 1931, however, the du Pont company came into possession of a greatly improved camphor process and, even though the price had dropped to $0.35, manufacture again appeared attractive. A second plant was built in 1932 having an annual capacity of 1,200,000 lb. and has been successfully operated for over a year. The chemical operations are essentially those used in the earlier plant except that pinene is now commercially available and it is no longer necessary to obtain it by fractionating turpentine. The pinene is saturated with HCl to form bornyl chloride, which is first hydrolized to give camphene, then esterified and saponified to give isoborneol. This is readily oxidized to camphor and purified by sublimation and fractional distillation.

Dr. Elley, in presenting the paper, distributed small samples of the new product, which appeared to be superior to natural camphor, although it has not yet been accepted by the U.S.P. for medicinal use.

The naval stores symposium was in charge of Dr. F. P. Veitch of the U.S. Bureau of Chemistry and Soils and was held under the joint sponsorship of the agricultural and industrial divisions of the society.

OTHERS' VIEWS

Chemical Engineers in Kimberly Clark Corp. Organize

To the Editor of Chem. & Met.:

Sir—After reading the survey of the work done recently by the Engineers' Council for Professional Development[1] the thought occurred that perhaps you would like to have information relative to our group of chemical engineers.

On Feb. 23 this year we initiated a Society of Chemical Engineers comprised of men of chemical engineering experience and training in Kimberly Clark Corp. Our membership is limited to 30 men actively interested in technical and social advancement, meeting once each month at regular dinner meetings to hold lectures and discussions of a seminar nature. We hope to accomplish the following:

1. Social and technical development through active, planned programs.
2. Freedom from the conventional type of technical meetings which yield little due to (a) Non-applicable subjects, (b) Opinionated discourses to favor the sales of some organization.
3. An eventual recognition by a professional engineering society such as A.I.Ch.E. as a means of bridging the gap between school and professional practice.

Of the 30 members, four are A.I.Ch.E. members and perhaps 15 are professionally eligible at the present time. The balance would undoubtedly be eligible after they had been professionally recognized.

In organizing this group it was strongly felt that most professional national groups had made no provision for men between the junior member stage and the active professional stage. It was also felt that even the active members of a national professional organization would profit from the contacts made in such a group.

To become a member of this group the candidate must make application, if he can satisfy the requirements. He is then voted upon, a favorable vote of 90 per cent required for election.

The requirements are:

> Eight years chemical engineering experience[2], plus a high school education. Each year lacking from a high school education to require two additional years of experience. Each year of college training to replace one year of experience. Each year of recognized chemical engineering training to replace 1½ years of experience.

For the most part the programs originate from a member at the request of the program committee. He usually delivers the main address, followed by several picked speakers on the more detailed phases of the problem. The meeting is then turned over to the general discussion and oftentimes heated arguments arise. No attempt has been made to record the address or discussion for later distribution, although this phase may develop later.

HAROLD E. WRIGHT

Secretary and Treasurer, Society of Chemical Engineers, 636 Grove St., Neenah, Wisconsin.

[1]See article in January, 1934, *Chem. & Met.* by Dr. H. C. Parmelee, pages 16 and 17.

[2]Experience acceptable only when in operation, control, development or plant layout of processes involving chemical engineering operations.

Permanent Relief Organization

To the Editor of Chem. & Met.:

Sir—The Committee on Unemployment and Relief for Chemists and Chemical Engineers in Metropolitan New York was organized as a temporary measure to span the period of emergency. The end of this period is rapidly approaching, but to those who have been associated with the work of the Committee and in touch with conditions that exist among the technical men in this country it is obvious that the work of the committee has only just begun. Present day economic conditions make it urgent that the organization be placed on a permanent basis, that it be made national and that its purpose be broadened.

The chemical profession thus far has given considerable attention to the development and promotion of scientific activities which is out of proportion to the welfare of the individuals responsible for same. In normal times, the distress among those who were deprived of their positions for reasons beyond their individual control was not quite as acute as in the period of economic depressions. The industry, therefore, cannot overlook this important item relating to the economic stability of its workers. Careful and scientific consideration in correcting this defect in the future should be immediately planned.

It is very difficult to present a clear-cut formula as a solution for numerous individual problems. Permanent solution of their difficulties, however, can be found by continued research and survey in the following directions:

1. Adaptation of specific qualifications for chemists and chemical engineers.
2. A thorough census of individuals to indicate the strength of qualified men and women in the profession.
3. A census of chemical concerns and the number of qualified chemists and chemical engineers employed by same.
4. A census of executives and persons controlling the chemical industry and their general training in scientific fields.
5. A census of educational institutions and the average number of graduates and post-graduates entering into the industry from these institutions every year.
6. A census of personnel connected with educational institutions and employees of City, State and Federal scientific bureaus and other non-commercial technical institutions.
7. Study of salary standards as determined from the educational abilities or from experience in specific fields.
8. Thorough study of seasonable unemployment and its causes.
9. Study of the turnover in specific chemical industries and remedies to minimize same.
10. Number of graduates and post-graduates entering into the technical field from the annual immigration sources.
11. Figures showing the average number of jobs available in normal times as compared with the applicants suitable for same.
12. Number of newcomers from colleges and universities, compared with the average human obsolescence.
13. A plan to take care of men and women above a certain age limit who have lost their positions and hence find it difficult to get work in their own lines.

It is hoped that leaders in the chemical profession will give the needed support for the proposed program.

M. R. BHAGWAT, Secretary

Committee on Unemployment and Relief for Chemists and Chemical Engineers, 300 Madison Ave., New York, N. Y.

Correction—In the article on "Adsorption, Refrigeration and Compression for the Drying of Gases," appearing in our issue of March, 1934, corrections as follows should be made at the top of the first column on page 129: In line (4) "Hungerford" should read "Huntingford" and in line (5) "heats" should read "effects."

BOOKSHELF

What About Costs?

COST AND PRODUCTION HANDBOOK. Edited by L. P. Alford and a Board of 80 Specialists. The Ronald Press Co., New York City, 1934. 1,600 pages. Price, $7.50.

COST ACCOUNTING, PRINCIPLES AND METHODS. By *Charles Reitell*. International Textbook Co., Scranton, Pa., 1933. 441 pages. Price, $3.50.

UNIFORM COST ACTIVITIES IN TRADE AND INDUSTRY. Prepared by Policyholders Service Bureau, Group Insurance Division, Metropolitan Life Insurance Co., New York City, 1933 46 pages.

Reviewed by *George A. Prochazka, Jr.*

INTER-COMMODITY and corporate competition have forced business into adopting a cost-controlled production. Circumstances usually make it necessary to manufacture to a price. The underlying principles of modern practice along these lines are clearly summed up in the "Cost and Production Handbook." The text represents a distinct advance over the "Management Handbook," which Mr. Alford brought out some ten years ago to cover a related field. The new book, in 28 sections, covers comprehensively such subjects as business reports, budgets, organization, planning, labor, material costs, plant, equipment, cost determination, research and industrial engineering. Section 21, on cost analysis, is particularly significant.

The field embraced by the volume is so large that of necessity the compilation of the text must have been a severe tax on editorial effort. Unfortunately for those engaged in the process industries, the viewpoint tends to lean toward the machine tool industries. Those who have given serious thought to interest on investment as a cost element are not apt to obtain instruction from the discussion of this topic. More than logic must be thrown into the balance of reasoning even to admit that the subject is controversial. Interest on investment is not a legitimate element of manufacturing cost even though some support for so charging it is to be had from the fiction of imputed interest devised by theoretical economists in order to lighten the opprobrium that has been cast as the interest gatherer for most of recorded history. It is difficult to dodge the accepted significance of lending capital at interest and of using it for profit. Practical considerations, accounting rules, and federal laws make it simpler and equally effective to dispose of the problem by merely contrasting current interest rates with the per centum of earned net profits. Looking beyond such criticisms as have been cited, it is obvious that the general merits of the text will obtain for the book a useful place in the reference library of the forward-looking executive.

"Cost Accounting, Principles and Methods," by Dr. Charles Reitell, immediately makes one aware that the author knows his business. The book has been written from so broad a viewpoint that it should be useful to those engaged in any line of manufacturing. The student who has progressed sufficiently to realize the futility of mastering cost work by a mere reading of a text will profit greatly by following through the well chosen examples which Dr. Reitell has drawn from his wide experience.

"Uniform Cost Activities in Trade and Industry" is an important pamphlet on the history and objectives of this movement. On page 36, there is recorded a thought valuable for those engaged in furthering uniform cost practices. Indeed it is a thought that might profitably be given consideration by every trade group. Industry will benefit greatly if such agencies devote less of their energies to the details of technique and more of them toward getting executives to think correctly on the fundamentals of cost determination. To secure general progress this work must be, not dogmatic, but educational. Perhaps after all, those many ills which have been ascribed to a lack of knowledge of true costs are but due to those smart practices of dressing up two and two in such fashion that the public contentedly accepts the sum for some quantity other than four.

Worden on Patents

CHEMICAL PATENT INDEX (U. S. 1915-24). Vol. III and IV. By *Edward Chauncey Worden*. The Chemical Catalog Co., Inc., New York. 1,004 and 1,132 pages. Price, $25 a volume.

Reviewed by *B. H. Strom*

HERE in the third and fourth volumes are included the U. S. chemical patents for the ten-year period 1915-24, covering the subjects under the letters F-L and M-R, and containing a total of 160,-200 and 180,800 patent citations, respectively. The system of classification is the same as used in previous volumes. A careful examination has been made of all patents listed in the Official Patent Gazette, and all containing anything of chemical nature have been indexed with sufficient accuracy to cover the chemical subject matter from any possible angle, each item being handled separately.

In addition to the patents for chemical processes and products, the uses of the products are also included in the index. The precise state of the patent art for any subject may be ascertained almost at a glance, eliminating laborious and often unsatisfactory methods of research. The handbook should furnish stimulus to chemical invention and research. Dr. Worden and his associates have made an outstanding contribution to the reference literature of the world.

TEXTBOOK OF INORGANIC CHEMISTRY. By *Fritz Ephraim*. English Edition II. Translated by P. C. L. Thorne. Gurney & Jackson, London. 873 pages. Price, 28s.

MUCH MATERIAL usually not appearing in a textbook of this size has been included in the present volume, and a number of isolated facts in inorganic chemistry have been grouped in a rational manner to facilitate easy assimilation by the reader. The present edition is based on the fourth German edition, but a great deal of additional material has been added by the author.

THE UNITED STATES AND THE SOVIET UNION. A report by the Committee on Russian-American Relations of the American Foundation. 279 pages.

THIS REPORT has been made with the purpose of analyzing the relations between the United States and the Soviet Union, with special reference to the issue of recognition. Although such recognition has already become an accomplished fact, the book has lost none of its actuality. With the increased commercial activity which may logically be expected from this step, the interested citizen is in need of a competent selection and presentation of facts, dissociated from the prejudice and bias which has tainted most of the information on this question. Included in the subjects discussed are, the Russian debt; claims for confiscated property; the Soviet counterclaims for intervention; propaganda; the religious issue; trade and credits.

LES EXPLOSIFS. By *W. Main*. Gauthier-Villars & Cie., Paris. 200 pages. Price, 25 Fr.

BESIDES THE special features required only by the expert this work contains much information of general interest to the user of explosives, the min-

ing engineer, the construction engineer, and the military worker. It deals with composition and properties, methods of manufacture, and applications of the important types of explosives. A theoretical treatment of the subject and a bibliography have been included.

PROCEDURE HANDBOOK OF ARC WELDING DESIGN AND PRACTICE. Published by the Lincoln Electric Co., Cleveland, 1933. 423 pages. Price, $1.50.

INTENDED NOT only for welders and welding supervisors, but also for those who design structures and equipment to be arc welded, the Lincoln Electric Co.'s new handbook is a clearly written and well illustrated treatise which accomplishes its purpose of bringing arc welding and its manifold applications up to date. The book is divided into eight sections which, however, are grouped logically into larger divisions as follows: The first, concerning equipment, technique, procedures and costs, properties of weld metal, and the weldability of metals, covers 122 pages. The second, dealing with design of welded machinery, comprises 100 pages, and the third, the design of welded structures, 88 pages. The final section, 92 pages, is a highly illustrated description of a large number of applications of arc welding that have recently been made.

STATISTICAL YEAR-BOOK OF THE LEAGUE OF NATIONS, 1932-33. Published in Geneva, 1933. Agents in the United States, World Peace Foundation, Boston, Mass. 292 pages. Price, $3.

AN INTERNATIONAL synopsis of available statistics relating to the most important economic, financial, demographic, and social phenomena is presented in this volume. To render the content of more current interest a table has been added, in which is given the balances of the Bank of International Settlements and a survey of the monetary restrictions in various countries. Two tables dealing with public finance —budget accounts and public debts—for a large number of countries have been brought up to date.

A FUNCTIONAL SIZE-ANALYSIS OF ORE GRINDS. By *Arthur J. Weinig*. Quarterly of the Colorado School of Mines, Vol. XXVIII, No. 3. 112 pages. Price, 50c.

PRIOR TO the advent of flotation the desired size distribution of ground materials could generally be obtained by screen analysis. Lately, however, it has become necessary to evaluate distribution of sizes so fine that screens are no longer adequate. The present work deals with this problem. For such measurements the microscope may be used to obtain certain size frequencies, a process known as the method of microscopic grain counts. Application of the sedimentation balance, in recent years used for fine products such as pigments and oozes, has also been found a valuable procedure in the analysis of the fine sizes of ore grinds.

GAUGING MANUAL. Published by Bureau of Industrial Alcohol, U. S. Treasury Department. Superintendent of Documents, Government Printing Office, Washington, D. C. 580 pages. Price, $1.00.

THIS VOLUME embraces the official instructions and tables for determining the quantity of distilled spirits by proof and weight, as effective Jan. 1, 1934, prescribed under Federal regulations by the Commissioner of Industrial Alcohol. The data are also significant and useful as alcohol tables for general industrial or laboratory use other than in official work.

QUANTITATIVE CHEMICAL ANALYSIS. By *G. McPhail Smith*. The Macmillan Co., New York. 199 pages. Price, $2.25.

AMONG THE outstanding additions in the new edition of this standard work is the inclusion of pH determinations which necessitated the revision of the section on Neutralization Methods. Numerous topics have been rewritten, various changes and improvements have been made in the analytical procedures and the notes, and some material has been added to bring the treatment up to date.

POCKET TABLES FOR CUBICS. By *David Katz*. Published by the author at 1414 Menomonee Ave., South Milwaukee, Wis. 6 pages. Price, 35 cents.

ANNOUNCED as a mathematical discovery of much practical value to engineers, chemists and physicists, this folder presents the author's simplified method for solving cubic equations without plotting, guesswork or approximation. The method is explained with examples and the new function used is evaluated in suitable tables for ready use.

SCIENCE OF RADIOLOGY. Edited by Otto Glaser. Published by Charles C. Thomas, Baltimore, Md., and Springfield, Ill. 450 pages. Price, $4.50.

INCLUDED in this volume, the main part of which deals with the theory and development of radiology and its application in the medical science, are chapters on industrial radiology, X-ray physics, X-ray tubes, the cosmic ray, and radio physics, all of which should prove interesting reading to most chemical engineers.

COMPARATIVE LIFE, FIRE, AND EXPLOSION HAZARDS OF COMMON REFRIGERANTS. Published by Underwriters' Laboratories, Chicago. 117 pages.

AMONG the refrigerants discussed in this report are ammonia, butane, carbon dioxide, ethane, ethyl bromide, ethyl chloride, methyl bromide, methyl chloride, dichlorethylene, dichlorodifluoromethane, dichlorotetrafluoroethane, monofluorotrichloromethane, propane, sulphur dioxide, and for comparative test purposes carbon tetra chloride and chloroform.

ANNUAL REPORT OF THE SOCIETY OF CHEMICAL INDUSTRY ON THE PROGRESS OF APPLIED CHEMISTRY. Vol. XVII. Issued by The Society of Chemical Industry. London. 728 pages. Price, Members: 7s. 6d.; Non-members, 12s. 6d.

AMONG the chapters included in this annual review may be mentioned, Gas, Fuel, Mineral Oils, Textiles, Pulp and Paper, Acids and Alkalies, Glass, Refractories, Oils and Fats, Paints and Pigments, Fertilizers, Sugars and Starch, Explosives.

A.S.T.M. PROCEEDINGS. The 36th Annual Meeting at Chicago, Ill. Vol. 33, Parts I & II. 1,092 and 804 pages.

PAPERS on corrosion, protective coatings, petroleum products, concrete, ceramics, and rubber are included in these volumes.

QUALITATIVE ANALYSIS. By *J. S. Long, H. V. Anderson,* and *T. H. Hazlehurst, Jr.* Revised Edition. Prentice-Hall, Inc., New York. 266 pages. Price, $2.25.

IN ADDITION to minor changes, the new material added in the revised edition includes sections on molar and normal solution, colloids, and amphoterism; the analysis of anions has been greatly enlarged; the section on complex ions has been completely rewritten, and the chapter on atomic structure has been made to conform the latest theories in this field. The discussion of valence has been extended to include a more detailed treatment of non-polar valence and its relation to ionization.

Recent German Publications

DIE TECHNOLOGIE DES EDELSTAHLES. By *Alfred Kropf*. Wilhelm Knapp, Halle (Saale). 264 pages. Price, 12.80 Rm.

ALTHOUGH THIS book on special steels is intended to serve as a handbook for the metallurgist, it should also be very useful as a reference work for the consumer of these steels. It gives an up-to-date classification of all alloy steels, with composition, physical and mechanical properties, and principal applications, with main stress on the practical side of the question.

DEUTSCH - ENGLISCHES FACHWÖRTERBUCH DER METALLURGIE. By *Henry Freeman*. Otto Spamer Verlag G.m.b.H. Leipzig. 327 pages. Price, 25 Rm.

IN ADDITION to purely technical expressions the author has included in this metallurgical dictionary such general words as are frequently used in metallurgical literature in order to save the reader with a fair knowledge of German the time of consulting a second dictionary. The book is well arranged and contains a large number of new words and expressions not found in older dictionaries. To make the work as complete as possible the author has consulted about 1,200 technical catalogs, in addition to leading handbooks and periodicals. An extensive compilation of abbreviations and a set of conversion tables, alphabetically arranged, should be very useful.

ERMÜDIGUNGSFESTIGKEIT VON KESSELBAUSTOFFEN UND IHRE BEEINFLUSSUNG DURCH CHEMISCHE EINWIRKUNGEN. By *Cl. Holzhauer*. V.D.I. Verlag, Berlin, Germany. 73 pages. Price, 6.50 RM.

THIS TREATISE contains investigations on the effect of chemical influences on the endurance limit, at elevated temperatures, of materials used in boiler construction. The results given show the accelerating and retarding influence on the development of fatigue fractures in boiler materials, and serve to determine the conditions under which the various types of cracks develop.

DIE BEDECKUNGSTHEORIE DER PASSIVITÄT DER METALLE UND IHRE EXPERIMENTELLE BEGRÜNDUNG. By *Wolf Johannes Müller*. Verlag Chemie, Berlin. 102 pages. Price, 6 Rm.

AFTER A BRIEF REVIEW of earlier theories on the passivity of metals the author presents the development of a new theory on this difficult subject, based entirely on the laws of Faraday, Ohm, and Hittdorf, and on Nernst's theory on metal potentials. The conception on the nature of passivity also offers new views in the study of corrosion and should therefore be of interest to all concerned about that problem.

SCHWEFEL, GRAPHIT, JOD, BOR, MAGNESIT, TALK. By *O. Stutzer, W. Wetzel*, and *A. Himmelbauer*. Gebrüder Borntraeger, Berlin. 396 pages. Price, 32 Rm.

THIS is the fifth volume of O. Stutzer's comprehensive handbook on the deposits of the non-metallic minerals. Included are the deposits of sulphur, graphite, iodine, boron, magnesite, and talc.

MARKENBEZEICHNUNGEN IM FEUERFEST-FACH UND IM OFENBAU. By *L. Litinsky*, Leipzig. Published by the author. 98 pages. Price, 6 Rm.

AN ALPHABETICAL index of about 1,500 of the best known refractories and materials used in furnace construction, with properties and addresses of manufacturers. A bibliography on industrial furnaces has also been included.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

COMBUSTION ET DETONATION DES SUBSTANCES EXPLOSIVES. By *Marcel Patry*. Hermann & Cie., Paris. 182 pages. Price 45 Fr.

MANY of the phenomena involved in combustion and detonation of explosives have been discussed in this volume, in which are given the results of investigations conducted at the Scientific Institute of Nancy, under the auspices of the Scientific Explosives Committee. Decomposition and ignition at constant temperature, photographic study of detonation waves, and mechanism of wave transmission are among the problems studied.

DIE TECHNIK DER CHEMISCHEN OPERATIONEN. By *Walter Bader*. B. Wepf & Cie., Basel, Switzerland. 416 pages. Price, 20 Fr. (Swiss).

IN THIS BOOK, which is written principally for the student, the author deals with the general operating problems confronting the chemical engineer, and the typical apparatus and equipment used in the process industries. Included are chapters on mixing, separation, solution, handling solids, liquids, and gases, heat transfer, evaporation, crystallization, and distillation. A more complete index and some additional illustrations would undoubtedly add to the value of the book.

Bibliography of Chloropicrin, 1848-1932, by R. C. Roark. Department of Agriculture, Miscellaneous Publication 176; 10 cents.

The Technique of Chemical Weapons. Chemical Warfare Service Training Regulations No. 415-35; 10 cents.

Important Sugar-Beet Byproducts and Their Utilization, by A. W. Skuderna and E. W. Sheets. Department of Agriculture, Farmers' Bulletin 1718; 5 cents.

Detergents and Related Subjects. Bureau of Standards, Letter Circular LC403; mimeographed list of publications.

Cellophane. Bureau of Standards, Letter Circular LC402; mimeographed.

Alcoholic Beverages, Regulations and Codes as Follows: Alcoholic beverages regulations made by the Secretary of Agriculture under the Marketing Agreement and special permits under the license for the distilled spirits industry, A.A.A., Series 1, R-3; Labor provisions for the Distilled Spirits Industry as approved on March 21, 1934, N.R.A. Registry No. 102-19, 5 cents; Proposed labor provisions for the Alcoholic Beverage Wholesale Industry, as revised for hearing March 16, 1934, N.R.A. Registry No. 102-21, 5 cents; Proposed labor provisions for the Distilled Spirits Rectifying Industry, as revised for hearing on March 15, 1934, N.R.A. Registry No. 102-10, 5 cents.

Accidents in Manufacturing Industries, 1926 to 1932, by Swen Kjaer. Bureau of Labor Statistics, Serial No. R. 61. Statistics of frequency and severity by industries.

Federal Specifications. New or revised specifications of the Federal Specifications Board on: Brick, fire-clay, 32B2a; Leather, artificial, 34L5a; Lubricants and liquid fuels; general specifications (methods for sampling and testing) VV-L-791; Cement, silica, HH-C-176; Oil, illuminating (300 deg. Mineral-Seal), VV-O-391; Oil, illuminating, long-time burning, VV-O-381. The above specifications are available from the Bureau of Supplies and Accounts, Navy Department.

Statistical Study of New York Imports in 1933 of Chemicals "not specially provided for" in the Tariff Act of 1930. U. S. Tariff Commission Release March 26, 1934; mimeographed.

Fine Grinding in Ore Concentrators, by Alexander M. Gow and others. Bureau of Mines, Information Circular 6757; mimeographed. Résumé of commercial practice.

Mineral Physics Studies, by R. S. Dean and others. Bureau of Mines, Metallurgical Division, Progress Report No. 1, Report of Investigations 3223; mimeographed document including articles on magnetic separation of minerals, deformation of solids, explosive shattering of minerals, crushing resistance of minerals, and dust settling.

Supplement to List of Publications, Bureau of Mines, July 1, 1932, to June 30, 1933, with subject index.

Mineral Production Statistics for 1932—Statistical appendices to Minerals Yearbook, 1932-33, on: Sand and Gravel by H. H. Hughes and M. Allan, 5 cents; Natural Gas, by G. R. Hopkins and H. Backus; 5 cents.

Mineral Production Statistics for 1933—preliminary mimeographed statements from Bureau of Mines on: Sulphur; zinc; sand and gravel sold or used by producers in the United States by uses and states; gypsum.

PLANT NOTEBOOK

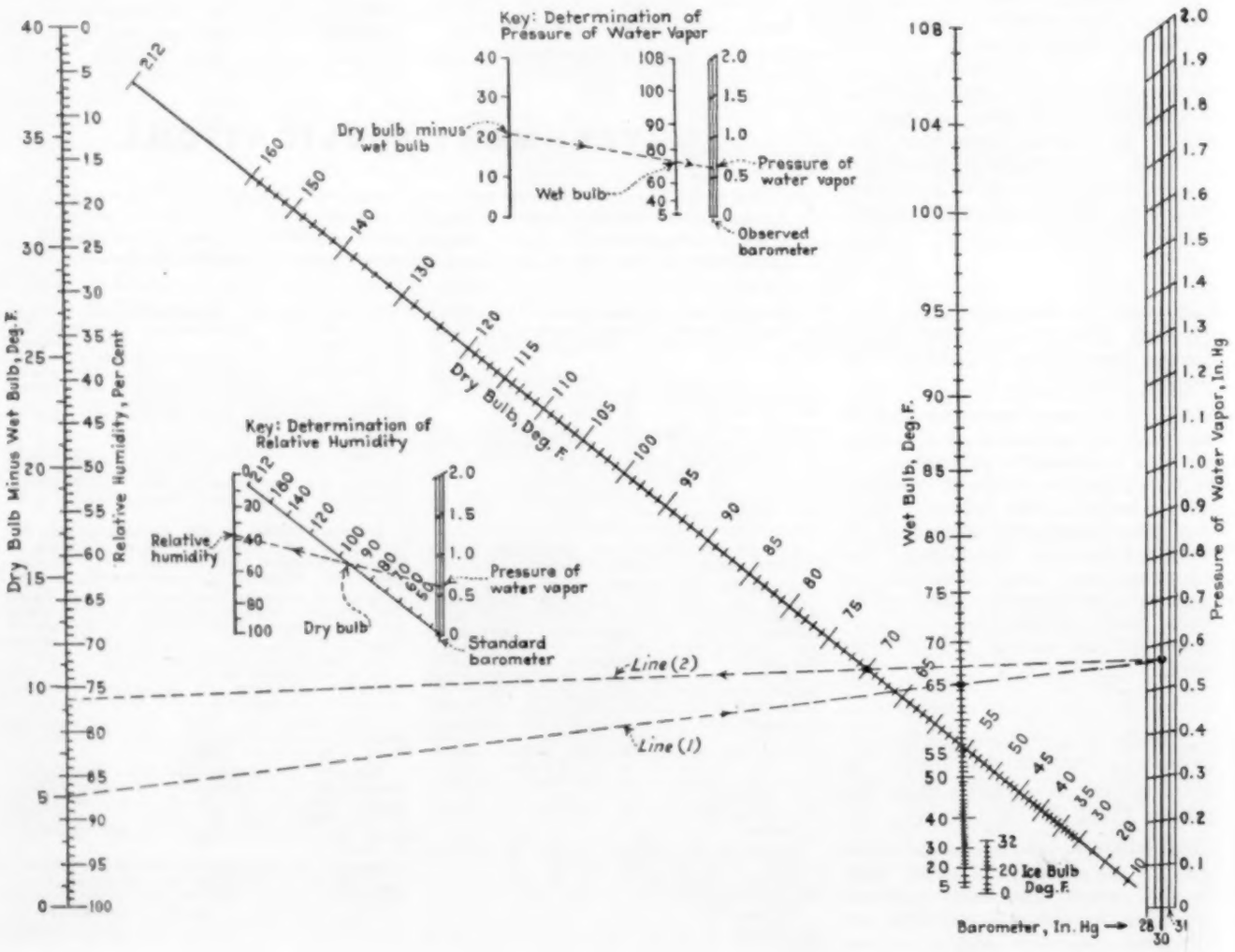
Alignment Chart for Solving Psychrometric Calculations

IN A RECENT miscellaneous publication, No. 143, of the U. S. Bureau of Standards, Donald B. Brooks gives a new alignment chart based on the Ferrel psychrometric formula which is used by the U. S. Weather Bureau in its psychrometric tables. The chart facilitates the determination of vapor pressure of water and relative humidity, using data obtained in psychrometric observations. In comparison with using the customary double interpolation tables, the new chart increases the precision and halves the time.

To use the chart place a straight-edge so that it intersects the extreme left-hand scale at the value of the difference between the wet and dry bulb temperatures, and intersects the wet-bulb scale at the value of the wet-bulb temperature. If the wet-bulb temperature is below freezing, use the "ice-bulb" scale.) Extend the line to the right to its intersection with the vertical line corresponding to the barometric pressure and read the correct vapor pressure at this intersection. For example, with a wet bulb of 65 deg. F., a dry bulb of 70 deg. F., and a barometer of 30 in., the pressure of water vapor is 0.57 in. Hg as shown by the dashed line marked (1). To determine the corresponding relative humidity transfer the vapor pressure to the 30-in. barometer line, if it is not already there, and connect this point by straight edge through the dry bulb (70 deg.) to the desired relative humidity (76.3 per cent) on the left-hand scale. This is shown by the dashed line marked (2).

Chart of Comparative Fuel Prices

ON THE opposite page we reproduce through the courtesy of the W. S. Rockwell Co., New York City, a chart which has been developed for the ready comparison of equivalent fuel prices, as influenced by efficiencies of utilization. Each sloping line represents a fuel for which possible prices are indi-



cated by the vertical lines which it crosses. For each fuel the price unit is as indicated in the key, the gases, for example, being priced in cents per M cu.ft. Vertical lines represent prices to the right of the heavy vertical, efficiencies to the left.

To use the chart, locate the point representing the cost of a particular fuel, for instance, fuel oil at $0.10 per gal. as shown by the dashed line. Follow horizontally to its use efficiency, say, 30 per cent. For a comparison with electricity used with 90 per cent efficiency, parallel the sloping efficiency line to 90 per cent, then follow horizontally to the line for electricity, at an equivalent price of $0.0075 per kw.-hr. If instead of electricity the comparison is to be made with coal, in the case of an oil efficiency of 18 per cent, follow the sloping efficiency line to the coal efficiency, say, 6 per cent, then go horizontally to the 12,000 B.t.u. coal line at an equivalent price of $6 per short ton.

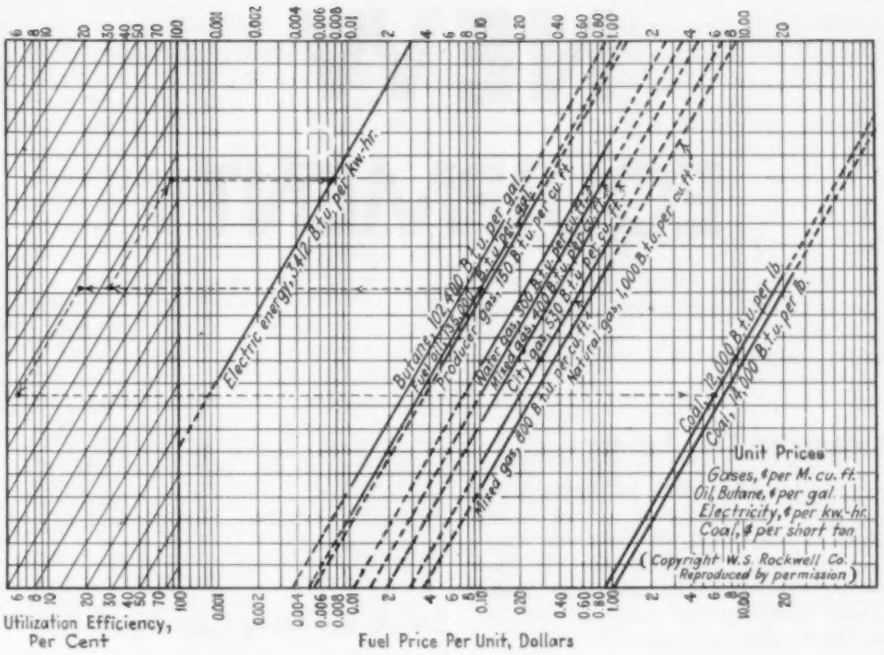

Electric energy, 3,412 B.t.u. per Kw.-hr.
Butane, 102,400 B.t.u. per gal.
Fuel oil, 150,000 B.t.u. per gal.
Producer gas, 150 B.t.u. per cu. ft.
Water gas, 300 B.t.u. per cu. ft.
Mixed gas, 500 B.t.u. per cu. ft.
C.W.F. gas, 530 B.t.u. per cu. ft.
Natural gas, 1,000 B.t.u. per cu. ft.
Coal, 12,000 B.t.u. per lb.
Coal, 14,000 B.t.u. per lb.
Unit Prices
Gases, ¢ per M. cu. ft.
Oil, Butane, ¢ per gal.
Electricity, ¢ per kw.-hr.
Coal, $ per short ton
(Copyright W.S. Rockwell Co. Reproduced by permission)
Utilization Efficiency, Per Cent
Fuel Price Per Unit, Dollars

Chart of comparative fuel prices

Truck-Mounted Pump For Decantation

By Delbert E. Jack

Berkeley, Calif.

WHEN the alum plant at the Stauffer Chemical Co., Stege, Calif., was recently rebuilt, considerable thought was given to the best method of skimming the alum liquor from the bauxite-sulphuric acid mixing tanks. Installation of the customary swing-joint skimming line with the moving joint immersed in the corrosive mud that settles in the bottom of the tank, presented an item of considerable expense and continual repair which, if possible, was well worth avoiding.

The solution (shown in the illustration below) was to mount a No. 80 Duriron self-priming pump on a truck which ran on the industrial track rails in front of the three tanks. Rubber hose for both suction and discharge lines made the installation complete. Adjustment of the suction line to skim off the alum liquor to the desired point is very easily accomplished.

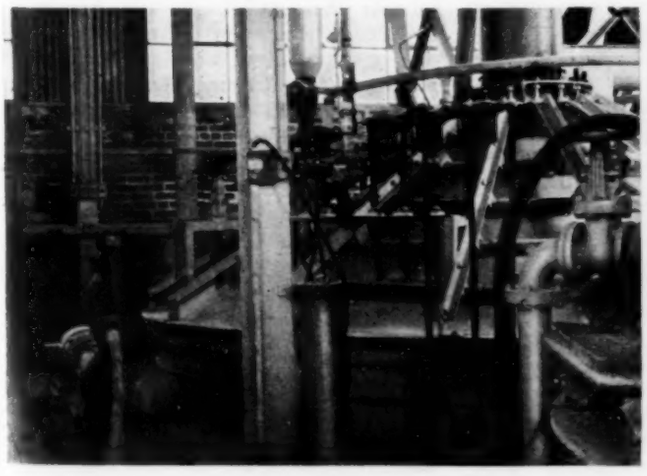
Spotting Heavy Equipment With "Dry-Ice"

A NEW and interesting new method for placing heavy equipment has been used with success by the engineer in the plant of a large New York ice cream manufacturer.

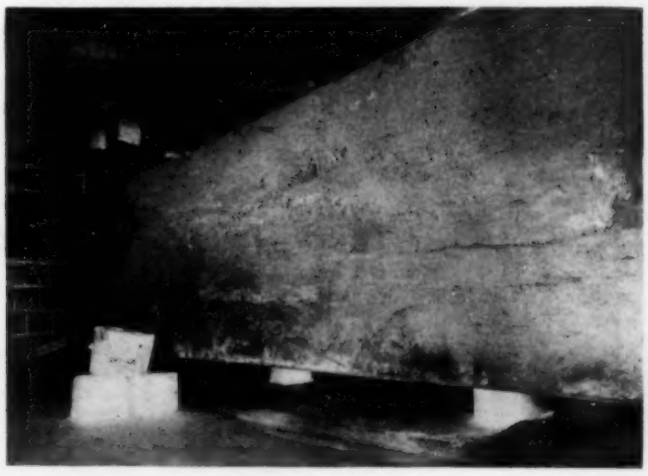
The problem was to spot on a flat foundation a rectangular, welded, steel brine tank, approximately 20 ft. x 13 ft. x 5 ft., weighing 6,500 lb. The tank was fabricated on wooden cribbing placed so that all parts of the tank were accessible for welding.

Six blocks of solid carbon dioxide, each a 10-in. cube, were next evenly spaced on the foundation. The tank was moved approximately into place and lowered by jacks until it rested directly on the "Dry-Ice." So placed, the friction between the tank bottom and the blocks was so slight that the entire tank could be moved into exact position by one man pushing against it. It was then braced to prevent any lateral shifting, and allowed to settle to its final position as the blocks vaporized. As solid CO_2 can sustain loads up to 11 lb. per sq.in., the method is believed to be applicable to the lowering of all kinds of heavy equipment where space is cramped and overhead crane facilities are not available.

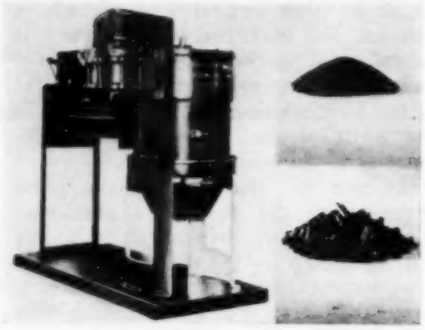
Mobile centrifugal pump for skimming alum solutions



Brine tank on solid carbon dioxide blocks



NEW EQUIPMENT



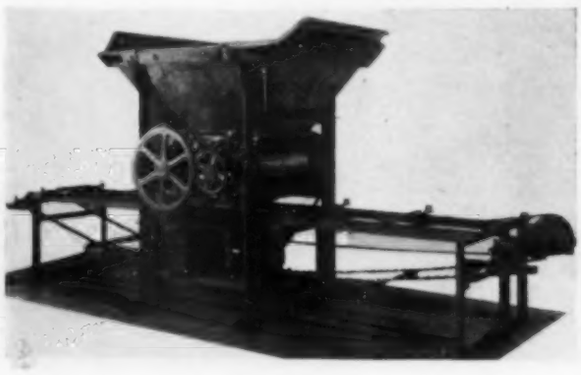
Pellet machine and sample of pelleted charcoal

Automatic Tray Loader

To insure uniformity in loading dryer trays and to avoid over drying at the edges of the trays, the Sherman Engineering Corp., 110 East 42d St., New York City, has developed a tray loader which compacts the material into individual strips of standard width and thickness which are laid down in the trays with $\frac{1}{2}$ in. spacing between strips. By this means, lumps and air spaces are eliminated and drying surface is said to be increased by as much as 200 per cent, more than making up for the smaller volume of material placed in the trays. Per pound of material and for equal depth, drying cycles are said to be reduced by as much as 50 per cent.

The loader is illustrated below and consists of a hopper supported above a pair of rolls which rotate over a tray conveyor. One roll turns at twice the speed of the other and serves to feed material on to the second. Movable sections on the forming roll mold the material into bars or strips for delivery to the trays. The trays, which are not shown, are placed on the conveyor at one side, pass under the rolls and are filled, and are then carried out the discharge side where they may be picked up for placing in the dryer.

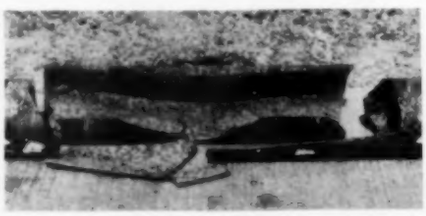
In tests it has been found that the loader accomplishes in 6 man-hours a job that requires 35 man-hours by hand filling. It is said to be possible to load between 8 and 30 trays per minute, as compared with a maximum of one tray per man per minute for manual labor. Depending on the type of service, the manufacturers are prepared to supply the loader in bronze, aluminum or chromium plate.



Sherman automatic loader for dryer trays

Shock-Resisting Cast Pipe

Increase in impact resistance of more than 100 per cent is the outstanding feature of a new product known as Super-de Lavaud pipe which has been announced by the United States Pipe & Foundry Co., Burlington, N. J. This company has been producing centrifugally cast pipe by the de Lavaud process for over ten years. Recently it undertook to develop increased impact resistance, which was accomplished first by a method of avoiding the chill heretofore produced in metal molds, and second by a low-temperature annealing process. The chill is prevented by the application of a pulverized material, with a carrier gas, on to the surface of the metal mold immediately preceding contact of the iron stream. The process is said to result in close grain, good machining characteristics and increased toughness.



Broken section revealing non-shattering characteristics

Pellet Machine

California Press Mfg. Co., 1818 Folsom St., San Francisco, Calif., has developed a pellet mill which, through the use of very high pressure plus a twisting effect, has been successful in pelleting minerals and dry feed materials. In a recent test, dehydrated charcoal of a very fine mesh was made into firm sticks such as those shown in the illustration. This was accomplished entirely without the use of a binder. It is claimed that many bulk minerals, pelleted in this manner, are handled more conveniently than in the loose state. California Mills have a capacity as high as 25 tons per day on certain materials.

Equipment Briefs

For the heating of fuel oil and similar viscous materials, Griscom-Russell Co., 285 Madison Ave., New York City, has introduced a new Twin G-Fin heater which employs tubing, the external surface of which is extended by the attachment of numerous radial fins parallel to the tube axis. The current adaptation of this heat exchanger employs two pipes attached by a return bend, provided with a concentric casing and suitable inlet and outlet connections. Units may be connected in series or parallel as desired, and have no internal joints.

Pyle-National Co., 1334 North Kostner Ave., Chicago, Ill., has introduced a new water-tight, vapor-tight and explosion-proof conduit fitting for making electrical connections in Class I Group D, and Class II Group G hazardous locations. The fitting consists of a length of flexible metal pressure tubing provided with connectors at either end.

For use in oil and gas fields, and similar applications, the Ingersoll-Rand Co., Phillipsburg, Pa., has developed a complete new line of direct-connected, gas-engine-driven compressors for air and gas. The units consist of vertical four-cycle, multi-cylinder, V-type gas engines with direct-connected, standard, horizontal compressor cylinders. Sizes range from 60 to 260 hp. with from two

to eight power cylinders, two power cylinders for each compressor cylinder.

To avoid the tendency of a belt to corrugate and reduce its area of contact when passing over a small diameter pulley, Alexander Bros., Inc., Philadelphia, Pa., has introduced the new Monobelt which is said to increase adhesion and reduce stretch and internal friction. The new feature is to employ on the pulley side of a double-ply belt a special vegetable-tanned leather which has been thoroughly stretched. The outer ply has more elastic stretch than the inner one.

For handling up to 5 watts at 110 volts with a primary contact current of only 3 microamperes, the Weston Electrical Instrument Corp., Newark, N. J. has developed a new supersensitive relay, Model 705. It is used with this company's Photronic cell for industrial control, and with thermocouples for the control of temperature in electric furnaces.

A new alloy, Anaconda beryllium copper, made by the American Brass Co., Waterbury, Conn., contains about 97.75 per cent copper alloyed with beryllium. The alloy may be readily formed in the annealed state, and subsequently heat-treated to improve its physical characteristics, particularly hardness and spring qualities. It is suitable for the manufacture of non-sparking tools used in handling explosive and flammable materials.

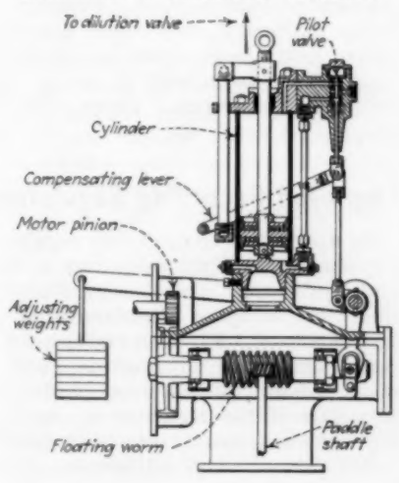
Stock Consistency Regulator

Control of the consistency of pulp and paper stock in the range from 2 to 5.5 per cent is the function of the new Model VH consistency regulator introduced by the Merritt Engineering & Sales Co., Lockport, N. Y. Guaranteed accuracy of the new regulator is within 0.125 per cent.

The regulator consists of a special type of transmission driving a paddle within a small vessel through which stock is circulated by a pump. The transmission is so designed that the load on the paddle, proportional to the consistency of the stock, is reflected in the setting of a pilot valve which, through the interposition of an hydraulic cylinder, controls the stock dilution valve. Dilution water enters the stock pipe between the chest and the pump. Part of the pump discharge is led to the regulator where its correctness of consistency is checked, after which this stock is returned to the chest.

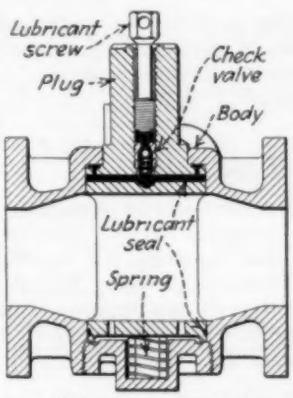
An accompanying illustration portrays the construction of the transmission, pilot valve and hydraulic cylinder. Drive of the paddle is accomplished through a floating worm, endwise motion of which is resisted by a weighted lever. Through adjustment of the weights, consistency may instantly be regulated at any value throughout the range mentioned. For each consistency the weighted lever assumes a definite position, adjusting the pilot valve and bringing the hydraulic piston to a definite location, in cooperation with a compensating device attached to the latter.

Mechanism of consistency regulator



Improved Plug Valve

Several new features are found in an improved, lubricated plug valve recently put on the market by the American Car & Foundry Co., 30 Church St., New York City. This valve, shown in cross-section in the sketch, employs a cylindrical plug. The short lubrication passages supply lubricant at all necessary points, sealing the stem as well, so that no packing is required. The number of parts has been reduced to the minimum.

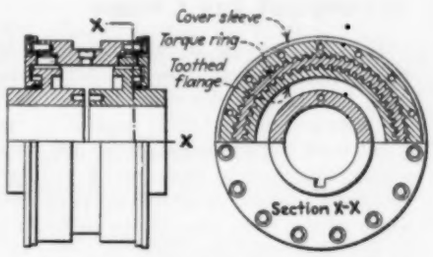


Cross-section of improved plug valve

Several interesting features arise from this construction. Head leaks are avoided by reason of the fact that the opposed forces, due to line and lubricant pressures, are maintained essentially equal and subject to manual control. The fact that the lubricant is automatically and visibly discharged around the neck of the plug when predetermined lubricant pressures are exceeded, is said to prevent building up of excess pressure. On this account, also, the valve is said to be economical of lubricant. It is available in sizes from ½ to 16 in., in pressures to 250 lb. Sizes to 8 in. are made in three-port designs as well. The valves are built in materials as desired and supplied with lubricants for chemicals, solvents, gases and steam.

Torque Ring Coupling

In the accompanying drawing is illustrated the principle of a new flexible coupling which makes use of quadruple engagement, giving four points within



Side and end sections of Torque Ring coupling

the coupling at which relative movement can freely take place. This is the Torque Ring coupling manufactured by John Waldron Corp., New Brunswick, N. J., and offered for sale by Smith & Ferrell, Globe Indemnity Bldg., Newark, N. J.

Briefly, the new coupling consists of two hubs of identical construction with toothed flanges at their centers. These hubs are attached to the two connected shafts and engage through their flanges two torque rings which are loosely held within a cover sleeve. Teeth cut in the perimeters of the torque rings engage similar teeth in the sleeve and complete the coupling action. The end plates carry grease seals and serve to make a dust and moisture-proof seal. Couplings are operated under centrifugal lubrication and are available in sizes from 1⅞ in. to 12 in. shaft with ratings from 22½ to 4,840 hp. per 100 r.p.m.

Oil-Burning Boiler

Exceptionally high overall operating efficiencies are claimed for the new oil-built boiler for industrial purposes developed by the Cleaver-Brooks Co., Milwaukee, Wis. The new equipment, available in sizes from 5 to 500 boiler horsepower, and working pressures from vacuum to 200 lb., occupies one-third less space than past boilers of like capacity and utilizes a combined boiler and burner expressly designed for operating together. Combustion air is supplied by a blower. Through the use of automatic controls the unit runs intermittently, making steam only when actually necessary.

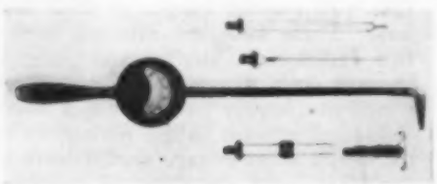
Bag sealer in operation

Waterproof Bag Closure

For the sealing of paper-lined cloth bags, Bemis Bro. Bag Co., St. Louis, Mo., has developed a new closure which employs a cemented strip applied by machine over the open end of the bag. The cement is entirely waterproof and sets instantly. Easy opening and easy handling of the bags are said to be features of the new method. This machine will seal from four to six bags per minute.

Combination Pyrometer

Illinois Testing Laboratories, 141 West Austin Ave., Chicago, Ill., is offering the new "Alnor" combination contact pyrometer with which as many as five entirely different styles of thermocouple may be used. The five points are shown in the accompanying illustra-

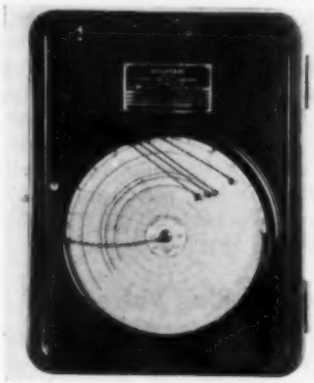


Combination pyrometer with available points

tion and make possible measurement of surface temperatures of bearings, metallic and non-metallic surfaces, such as molds, platens, etc., temperatures of plastic materials, of rolls and revolving cylinders, and of liquids and gases. The instrument is self-contained, weighing about 2 lb. with thermocouple. Thermocouples are quickly interchangeable and may be rotated through an angle of 360 deg. The standard range is 0-600 deg. F., although higher ranges can be furnished.

Electronic Potentiometer Pyrometer

Using electron tubes instead of the customary magnetic relays, the Bailey Meter Co., 1050 Ivanhoe Road, Cleveland, Ohio, has produced a new potentiometer pyrometer which is adjusted by high or low galvanometer contacts of duration proportional to the deflection of the galvanometer needle. These contacts close circuits carrying only a few microamperes of current and control a reversible synchronous motor driving the potentiometer unit through pliotron tubes. When the galvanometer is out of balance, requiring adjustment of the potentiometer slide wire, intermittent contacts are made in the proper direction until the synchronous motor has corrected the adjustment and returned the galvanometer to its null position. The new instrument records on a round chart and may employ as many as four pens. Control contacts are frequent and even in the case of a four-pen

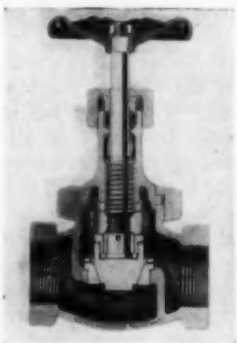


Four-pen potentiometer pyrometer recorder

recorder each pen is positioned every 16 sec. so that each record becomes a smooth, continuous picture of existing conditions.

Plug Type Valve

For severe service demanding maximum resistance to the destruction of valve seat bearings, the Lunkenheimer Co., Cincinnati, Ohio, has developed plug valves in two pressure ranges, employing this company's new NS5 alloy for seats and disks. This alloy is a



New plug type valve

non-galling, non-ferrous composition with a hardness of 300 Brinell, said to be resistant to wear, abrasion, erosion and corrosion and to retain its hardness at high temperatures.

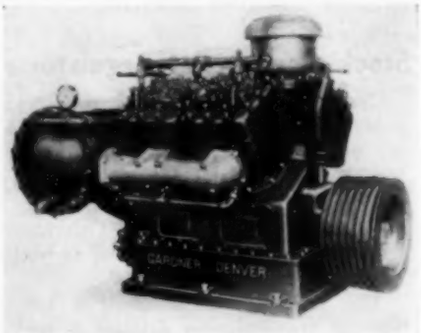
The lower pressure range, up to 150 lb. steam pressure, is called the Ferrenewo plug type, and the higher range, available in 200 lb. and 300 lb. steam pressure patterns, is called the Renewo. The former employs a bronze mounted iron body and the latter is all bronze.

Low-Cost Controller

Air-operated controllers for both temperature and pressure are being supplied in a new design by the Foxboro Co., Foxboro, Mass. On the face of the controller are a dial and knob for adjusting the temperature or pressure within the range of the instrument. An indicating gage placed above the knob shows the air pressure on the diaphragm motor. If desired, this gage may be replaced with a dial type thermometer or pressure gage showing the controlled pressure. The manufacturer stresses the low cost of the new controller. Type 1119 is the designation of the temperature instrument while that of the pressure controller is Type 2119.

Vertical Compressor

Gardner-Denver Co., Quincy, Ill., has announced new line of vertical water-cooled compressors for which marked economies in price, installation cost and



Four-cylinder vertical compressor

maintenance are claimed. Features include cushioned inlet and discharge valves, extra large water jackets and a water-cooled intercooler to assure high volumetric efficiency. Pump pressure supplies oil to all bearings.

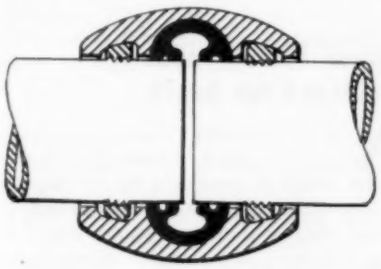
Improved Recording Regulators

In a new line of recording regulators for temperature, pressure, rate of flow and liquid level, known as the Fulscope line, the Taylor Instrument Cos., Rochester, N. Y., have introduced a novel sensitivity adjuster designed to make possible the matching of the performance of the regulator to the time lag or heat capacity of the apparatus under control. This adjustment, which

is easily employed, makes possible adjustment of the amount of pen arm movement required to cause the diaphragm valve to move from full open to full closed. Other features of the new regulator include light weight Duralumin mechanism, practically frictionless bearings, ready change from direct to reverse action, die-cast aluminum cases for face or flush mounting, synchronous electric clocks and interchangeability of parts.

Threadless Pipe Coupling

Pipes may be coupled without grooving, threading, beveling or upsetting the ends through the use of a new positive-seal pipe coupling manufactured by the Champion Machine & Forging Co., 3695 East 78th St., Cleveland, Ohio. The coupling is designed to grip the pipe,



Gasket-seal coupling for plain-end pipe

while tightness against pressures up to 4,000 lb. per sq.in. is secured through the use of a gasket which provides a double seal, equally effective against either pressure or vacuum. The complete coupling consists of but five parts, two drop-forged half coupling sections, one gasket and two bolts. Its use is said to be extremely simple, permitting the coupling of joints by unskilled labor at low cost. Joints may be made and broken as frequently as desired.

Equipment Briefs

To overcome the difficulties from slow response and hysteresis encountered in many diaphragm control valves, the Bristol Co., Waterbury, Conn., has introduced a new valve which has been given the name of Synchro. By the use of a molded rubber diaphragm, a large diameter spring, a flexible coupling in the stem and a low-friction packing gland, the response of the valve is said to have been made instantaneous and its aperture directly proportional to the pressure on the diaphragm, both in opening and in closing.

Motors ranging in size from ½ to 30 hp. manufactured by the Lincoln Electric Co., Cleveland, Ohio, may now be automatically protected against burning out by a built-in protective device which shuts off the current if, for any reason, the motor should overheat. These motors comprise a.c. induction machines for two or three phases in any standard commercial cycles and voltages.

Alternating current and a special organic pickling compound are employed in a new electrolytic pickling machine developed by Ferro Enamel Corp., Cleveland, Ohio. The new machine is said to have a lower investment cost than when direct current pickling is used and to give faster pickling and lower steam cost.

Resistance to shock and abrasion is said to be imparted to steel surfaces that are built up with a new shielded-arc electrode, the Wearweld, developed by the Lincoln Electric Co., Cleveland, Ohio. Such deposits are air hardening and suitable for building up all steels other than those of the austenitic type. Depending on the type of steel coated and the number of layers, the hardness of the deposit may be as high as 55 Rockwell C.

For the solution of corrosion problems in the pulp and paper industry, the Ingersoll Steel & Disc Co., Chicago, Ill., has introduced Ing-O-Clad 23-11, a two-ply stainless steel having a 20 per cent stainless layer of 23 per cent chrome, 11 per cent nickel, bonded to a back of mild carbon steel and produced by this company's Ingot process. The material is available in sheet and plate form in all commercial sizes and is stated to resist corrosion encountered in both sulphite and sulphate pulp and paper mill applications better than 18-8.

MANUFACTURERS' LATEST PUBLICATIONS

Bakelite. Bakelite Corp., River Road, Bound Brook, N. J.—48 pages showing the range of products now being made from molded Bakelite.

Chemicals. Eastman Kodak Co., Rochester, N. Y.—List No. 25—March, 1934, price list (112 pages) on this company's organic chemicals

Chemicals. Glyco Products Co., Bush Terminal Bldg. No. 5, Brooklyn, N. Y.—11 pages on emulsifying agents, synthetic resins and waxes, etc., made by this company.

Classifiers. Hardinge Co., York, Pa.—Leaflet briefly describing this company's new rotary classifier.

Couplings. Falk Corp., Milwaukee, Wis.—4 pages describing the Falk-Rawson automatic centrifugal-clutch coupling.

Electrical Equipment. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin 1165—16 pages on advantages and uses of this company's synchronous motors.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—GEA-77F, 28 pages on Pyranol-treated capacitors; GEA-1720B, 50 pages describing construction and uses of numerous types of heating element.

Electrical Equipment. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.—Leaflet 20609—Describes CR repulsion-start induction motors.

Equipment. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin 1473—28 pages on crushers, grinders, screens, washers, hoists and other equipment for crushing plants.

Equipment. The Swartwout Co., 18511 Euclid Ave., Cleveland, Ohio—Folder covering briefly this company's steam specialties and ventilation equipment.

Fuel. Philgas Co., General Motors Bldg., Detroit, Mich.—Leaflet describing the use of liquefied petroleum gases in internal combustion engines.

Furnaces. Hevi Duty Electric Co., Milwaukee, Wis.—Bulletin HD-334—6 pages illustrating the various types of industrial and laboratory furnaces made by this company.

Furnaces. Standard Fuel Engineering Co., 667 Post Ave. South, Detroit, Mich.—Bulletins 26, 27 and 28—4 pages each covering respectively large oven furnaces, pot furnaces and small oven furnaces.

Furnaces. Harold E. Trent, 618 North 54th St., Philadelphia, Pa.—Leaflet TD-20—4 pages on this company's pot and trough type electric furnaces.

Instruments. The Hays Corp., Michigan City, Ind.—Catalog RA-34—15 pages on combustion recorders.

Insulation. Johns-Manville, 22 East 40th St., New York City—72 pages on the insulation of industrial furnaces and ovens, with an appendix on refractory cements and packing.

Machinery. Farrel-Birmingham Co., Ansonia, Conn.—"The Job Ahead for Machinery," 15-page booklet, sixth of series of editorials, which discusses technological unemployment and shows that more rather than less machinery is needed for recovery and continued progress.

Metals and Alloys. Dow Chemical Co., Midland, Mich.—"Dowmetal Data Book," 64 pages on properties and uses of Dowmetal magnesium-base alloys, with appendix on protective and decorative finishes.

Metals and Alloys. Lukens Steel Co., Coatesville, Pa.—11 pages on the use of this company's nickel-clad steel in the process industries.

Metals and Alloys. U. S. Metals Refining Co., 420 Lexington Ave., New York City—Reprint of three papers on the properties of oxygen-free, high-conductivity copper.

Painting. Parker Rustproof Co., Detroit, Mich.—4 pages on the causes and prevention of paint failure.

Piping. Taylor Forge & Pipe Works, P. O. Box 485, Chicago, Ill.—Catalog 34-1—64-page catalog covering this company's welding fittings and flanges with prices, engineering data and information on design.

Pumps. Ingersoll-Rand Co., 11 Broadway, New York City—Publications as follows: Form 2078, 6 pages on multi-stage Cameron NT pumps for boiler feed; 7065, 12 pages on Cameron AHP centrifugal pumps, 10 stage, for charging hot oil at pressures to 1,250 lb.; 7464, 15 pages on Cameron Motorpumps in single and two-stage designs, to 4-in. size.

Pumps. Morris Machine Works, Baldwinsville, N. Y.—Bulletin 162—19 pages illustrating and describing this company's double-suction, horizontally split, centrifugal pumps.

Pumps. Worthington Pump & Machinery Corp., Harrison, N. J.—Publications as follows: D-423-S11A, 4 pages on vertical, single-acting, triplex pumps; D-475-S4A, rotary gear pumps; W-321-B1, Monobloc centrifugal pumps for brewhouses.

Refrigeration. Ingersoll-Rand Co., 11 Broadway, New York City—Form 9044—22 pages on history, principle and practice of centrifugal water-vapor refrigeration; Form 9043, 11 pages on steam-jet refrigeration.

Screening. Orville Simpson Co., 1230 Knowlton St., Cincinnati, Ohio—Bulletin 101—Leaflet describing the use of this company's Rotex screeners on chips in a sulphite mill.

Sulphur. Texas Gulf Sulphur Co., 75 East 45th St., New York City—25-page treatise on sulphur with reference to its history, occurrence, production, economics, properties, analysis, and use in agriculture and industry.

Traps. Nason Mfg. Co., 71 Fulton St., New York City—Catalog 33—20 pages on steam traps and steam specialties made by this company; 4-page folder introducing two new bucket traps made by this company.

NEWS OF THE INDUSTRY

Chemical Alliance organizes to carry out administrative features of chemical code. American Chemical society will study advisability of a federation of chemical societies. Code for commercial laboratories drawn up and carried through public hearing. Direct conversion of phenol into aniline reported in Germany. Cement manufacture may become part of T.V.A. program.

Electrochemists Will Meet With Ceramists

THIS year the spring convention of the Electrochemical Society will be held jointly with the American Ceramic Society. Grove Park Inn at Asheville, N. C., will be the headquarters. From here trips will be taken to neighboring mines, manufacturing plants and hydro-electric installations.

There are many important topics of interest to members of both societies. Thursday morning, April 26, and Friday morning, April 27, have been set aside for joint discussions on recent developments in these mutual subjects: Linings for electric furnaces, high voltage insulators, chemically resistant glass, etc. Among other things the new sodium vapor lamp will be dealt with at length. The commercial perfection of this lamp is due to both the glass chemist and the electrochemist.

Saturday, April 28, has been set aside for different reports on progress made in various branches of electro-organic chemistry, electro-refining and electroplating. Included in the reports is one on cobalt, another on germanium, and a third on indium. Cobalt is now produced in Canada, Tasmania and South Africa. Germanium and indium used to be very rare metals, but, due to improvements in the metallurgy of zinc, they have become frequent byproducts of the zinc industry.

Among those who will attend the convention will be Prof. J. B. Whitehead of Johns Hopkins, Prof. Vladimir Karapetoff of Cornell, Prof. Ralph H. McKee of Columbia, Prof. Chas. P. Smyth of Princeton, Dr. Harry A. Curtis of the Tennessee Valley Authority, S. T. Henry of Spruce Pine, N. C., V. L. Mattson of the Celo Mines, Inc., Prof. F. C. Mathers of Indiana University, and many others. Holland, England, South Africa, Sweden and Russia, besides the United States, have contributed to what promises to be a most successful convention.

Commercial Laboratories Draw Up Code

A CODE of Fair Competition for commercial research and testing laboratories which has been under development since last August was brought through a public NRA hearing at Washington on March 23.

In the earlier stages of this code development there was some uncertainty as to the need for a code for laboratories whose work partakes of a professional character, but nevertheless the movement was initiated as a measure of compliance with government purpose.

As codification proceeded it became evident that in the view of the National Recovery Administration the service is not professional when employees are remunerated by the week or the month and when the product of their knowledge, skill and labor is sold. It is the NRA view that organizations so engaged constitute an industry.

Exempted from the scope of the code are—research work carried out for public benefit; laboratory services of educational institutions for which commercial laboratory facilities are not readily available; testing work by manufacturers upon their own products and research and testing on the part of governmental institutions.

Among the trade practice provisions of this code are restrictions intended to maintain commercial laboratory services on a high plane and to insure the integrity of laboratory reports.

Potato Starch Industry Predicted for South

A NEW industry that may utilize now dormant cottonseed oil mills in the South is predicted by Department of Agriculture experts from recent developments in their investigations of the manufacture of starch from sweet potatoes.

This information was brought out during hearings before the House of Representatives Appropriations Committee on the Department of Agriculture appropriation bill for 1935.

Highly optimistic prospects for domestic production of commercial starches are seen by department chemists, they stated. The new industry has already begun with the erection of a plant in Georgia that will have an annual capacity of 360,000 bu. of sweet potatoes. Cull sweet potatoes are to be used.

Sodium Sulphate Development In Canada

THE East Crest Oil of Calgary, Alberta, has leased a plant for experimental purposes in developing of a process invented by D. W. F. Seyer, the professor of chemical engineering at the University of British Columbia, for the extracting of pure sodium sulphate from glaubers salts. The company has purchased about 500 acres of land near Oban, Saskatchewan, containing large deposits of glaubers salts. Following experimental work in the leased Calgary plant, where already 10 tons of sodium sulphate in granular form has been extracted, the East Crest Co. plans erection of a plant near Oban at cost of $35,000. Eventually the company plans to produce around 120,000 tons annually.

Chemical Alliance Plans Code Administration

STEPS toward setting up an organization to carry out the provisions of the Chemical Code will practically be completed at a meeting to be held on April 17. The Chemical Alliance, under whose direction the code was drawn up, is in charge of its administrative features. The executive committee of the Alliance already has elected officers, appointed committees. Officers include W. B. Bell, American Cyanamid Co., chairman; Charles Belknap, Merrimac Chemical Co., Willard H. Dow, Dow Chemical Co., Lammot du Pont, E. I. duPont de Nemours & Co., vice-chairmen; J. W. McLaughlin, Carbide & Carbon Chemicals Corp., treasurer; and Warren N. Watson, secretary.

Howard Huston, American Cyanamid Co., has been appointed acting code director.

The committees already organized include: Statistics — Geo. W. Merck, Merck & Co., chairman; E. V. O'Daniel and W. H. Winans.

Explanations—E. M. Allen, Mathieson Alkali Works, chairman; and H. C. Haskell.

Supplemental and Overlapping Codes —A. E. Pitcher, E. I. duPont de Nemours & Co., chairman; Glenn Haskell and Fred Russe.

Import Competition—H. M. Albright, U. S. Potash Co., chairman; H. L. Derby and W. F. Reich.

Licensing of Chemists Discussed by A.I.C.

AT the meeting of the Niagara chapter of the American Institute of Chemists held at Niagara Falls on March 10 a symposium was conducted on the subject of "Licensing of Chemists."

James Ogilvie, of the National Aniline and Chemical Co., discussed compulsory system of organization built up in England. The British Institute of Chemists has maintained an examination system for the Fellowship members which ranked with the best doctorate examinations and presented a uniform classification. The associate membership requires either a degree from an accredited school or an examination.

Arthur J. Norton, of General Plastics, Inc., introduced the subject "Should Chemists Be Licensed?" by pointing out the past benefits of organization to chemistry as a science, and of organization to chemistry as an industry.

Dr. Arthur W. Burwell, of the Alox Chemical Co., presented a type licensing bill for discussion.

The conclusion reached was that while the time for action was not ripe, the trend of events was leading definitely to a licensing bill being introduced to the legislature. The institute, as the only organization directly interested in the welfare of the chemist as an individual, is investigating the subject thoroughly so that, when the time comes, the chemists will be prepared to present and enact such a bill.

Sulphur Deposit Reported In Ontario

THE Department of Commerce reports that the American Engineering Co., a corporation formed by residents of Chatham, Ontario, has been drilling for sulphur, the presence of which has been suspected for years, on land in Lambton County at a point near Sombra, Ontario, and some four miles east of the St. Clair River. It is alleged that a two foot bed of pure sulphur was encountered at 817 feet. At a lower level a four foot bed of what appears to be sulphur was reported. This bed is somewhat whiter in appearance than that first encountered. A sample of the core taken from the second bed is being forwarded to the Ontario Government for analysis.

The tract on which the discovery was made is a swamp which is useless for farming operations. The American Engineering Co. now has under lease some 1,110 acres including and immediately surrounding the land upon which drilling operations occurred.

General Electric Co. Sues On Resin Patent

A BILL of camplaint has been filed in the Federal Court for the Eastern District of New York alleging infringement of patent No. 1,893,873 issued to Roy H. Kienle in 1933 and assigned to the General Electric Co. The patent covers a process for the manufacture of synthetic resins. The General Electric Co. has filed the complaint which charges the Paramet Chemical Co., Long Island City, with infringement of the patent and seeks to enjoin the defendant company from further manufacture and sale of resin which is alleged to violate the patent rights held by the General Electric Co.

Pure Carbonic Buys Dryice

Pure Carbonic Co. of America, subsidiary of Air Reduction Corp., has purchased business of American Dryice Corp. and has formed a company to be known as Dry Ice Co., Inc.

Japan Increases Demand For Caustic Soda

IN a report from Tokyo, assistant trade commissioner Donald W. Smith states that the activity in Japan's textile, paper and soap industries and the remarkable expansion of the rayon industry has greatly increased the demand for caustic soda during the past two years. Japanese consumption of caustic soda during 1933 was estimated at approximately 100,000 metric tons, of which about 40,000 tons was consumed in the manufacture of rayon. The production capacity is about 160,000 metric tons, and actual production during 1933 was approximately 107,000 tons. The Caustic Soda Manufacturers' Association allowed its members to produce at only 55 per cent of capacity during 1933. The most important Japanese manufacturer, Nihon Soda Industry Co., is not a member of the association and it produced at almost full capacity, or about 65,000 metric tons.

There was an increasing tendency during 1933 for Japanese soda ash manufacturers to convert soda ash into caustic soda. Several of the larger companies have announced their intention of increasing their output of caustic during 1934 by this method, in anticipation of the further expansion of the rayon industry. Although Japan is practically self-sufficient in caustic soda, it is still economical to import some supplies. Imports have declined from 41,612 metric tons in 1931 to only 12,527 metric tons in 1933.

Sales of Explosives Gained Last Year

THE quantity of explosives manufactured in the United States and sold during 1933 for use in mining and quarrying, and for other industrial purposes, amounted to 255,989,391 lb., according to reports received by the Bureau of Mines from companies engaged in the manufacture of explosives. This figure represents an increase of 9 per cent over the quantity sold in 1932. Sales during 1933 included 64,210,675 lb. of black blasting powder, 33,927,443 lb. of permissible explosives, and 157,849,273 lb. of other high explosives. When compared with 1932, the quantities of explosives sold in 1933 represented an increase of 5 per cent for permissible explosives, 14 per cent for other high explosives, and less than 1 per cent for black blasting powder.

Mining and quarrying operations used 99 per cent of the total quantity of permissible explosives, 51 per cent of the total quantity of other high explosives, and 92 per cent of the total quantity of black blasting powder.

NEWS FROM WASHINGTON

By PAUL WOOTON

Washington Correspondent of Chem. & Met.

PORTLAND cement manufacture by T.V.A. continues to be forecast in news dispatches from the Valley. Most of these stories are premature. The subject is officially admitted to be one of importance, but a decision to make cement on a commercial scale instead of buying it has not yet been reached. A fair statement of the situation is—Cement making may be feasible. It is being considered. Decision will be based on the possibility of independent operation, not intimate interlock with use of slag from the fertilizer furnaces.

T.V.A. has definitely announced that production of furnace phosphoric acid may be expected August 1. A. H. Miller, superintendent of plants at Muscle Shoals, announced recently that about 300 men are employed on construction and remodeling work in the phosphoric acid and fertilizer units. Steel orders and purchases of required wire and cable for these plants also have been announced.

A particularly noticeable revival of interest by the domestic chemical industries in world trade is reported by the Department of Commerce. Declaring that there has been a considerable increase in the number of inquiries concerning foreign business prospects, department officials are inclined to attribute it to the favorable exchange situation now existing for this country.

They report that while the nationalistic viewpoint still exists to a large extent, particularly in chemicals, in most foreign countries, reports from representatives abroad indicate that there is a good field for exports of paints, varnishes, chemical raw materials, finished products in the consumer goods class, proprietary medicines, and toiletries. While they say that it is difficult to point out specific markets for the various articles, they insist that the tone is much better generally.

Sentiment among representatives of trades that have been here is to the effect that if it could get their codes and other government business out of the way American business would be looking for foreign trade.

Petroleum apparently will enjoy distinction as the only industry too big for NIRA to subdue. For years it has been lawless and when NIRA came along even General Johnson flinched at the prospect of trying to put this industry's operations under discipline. By common consent the job was delegated to Interior Secretary Ickes because of this department's previous attempts to induce the industry to adopt a little effective self-government. Now Ickes asserts that it will take a law bigger than NIRA to lick the oil industry and he is writing it.

Postal regulations have been amended to permit mailing packaged insecticides, fungicides and germicides except acids, lyes and other highly corrosives. The orders require that the containers be marked "poisonous composition" and labeled to show the contents and name of manufacturer. Packing requirements call for inside containers of metal, glass or fiber and outside containers of metal, wood or fiberboard. If the product is liquid, the inside container must be surrounded with sufficient absorbent material to absorb the contents, also packed in cushioning material. When the product is solid or powdered, the inside container must be surrounded with cushioning material.

Chemical manufacturers are requested by the Code Authority to file immediately their applications for posters of the labor provisions that, by Presidential order, must be posted in all plants.

Behind the Administration's sugar bill is still waging a fight between the two methods of refining.

Bone char refining is used by the large eastern seaboard refineries and in the largest and most recently built refinery in Cuba. The other method of refining through a vegetable char, known as the Suchar process, is used in the smaller Cuban refineries operated in conjunction with raw sugar mills and to a small extent in Louisiana.

In the past decade sugar refining has grown tremendously in Cuba, using to the greater degree the Suchar process. In an effort to spike this threat of competition, domestic refiners had incorporated in the sugar legislation a limitation on Cuban and insular area refined sugar imports.

Domestic refiners asked that Cuban direct consumption imports be held to 15 per cent of the total quota given the Island. Cuban refiners and Suchar interests contested for a 25% limitation when it became apparent that some restriction was to be provided. A compromise was reached at 22% and other insular areas are to have their direct consumption sugar imports limited to prevent increase.

A fight is to be made by Suchar interests to ease the restriction on insular area imports of direct consumption when the administration bill reaches the Senate.

The Suchar interests representative here is Frank Roberson, at one time attorney general of Mississippi and close to the present Administration.

In their fight for a restriction on refined sugar imports, the domestic refiners encountered bitter opposition from the brain trust element of A.A.A. Assistant Secretary of Agriculture Tugwell led the fight against restriction. He is one-third of the original Administration "brain trust." The other two were Charles W. Taussig and A. A. Berle, president and director and counsel, respectively, of the American Molasses Company, Cuban refinery.

Mr. Tugwell during the fight has charged the domestic refiners with efforts to continue "obsolete" refining methods. This was challenged and domestic refiners announced that they would gladly try another process.

In its amended form, the Wagner labor bill is not as repugnant as its first draft but still remains the "cupboard" which President Roosevelt will throw open if disturbances engendered by his proposal for increasing wages and reducing hours 10 per cent get out of hand. The 10-and-10 plan was labor's cue for an offensive to which industries are submitting, one by one. The alternative is the prospect that the "grand compromise" which averted the automobile strike will be written into law. The Senate waits on word from the White House and President Roosevelt is waiting on and watching developments. W. B. Bell, chairman of the Chemical Code Authority and president of the Manufacturing Chemists Association, testified in opposition to the bill before the Senate Labor Committee, declaring that far from encouraging amicable settlement it would encourage disputes.

Capt. J. F. Battley, of the Chemical Warfare Service, probably will succeed Dr. Charles H. Herty as NRA deputy administrator in charge of the chemical codes. Capt. Battley is assistant to Dr. Herty, now retiring from NRA to continue research in producing newsprint from southern pine, now limited to the manufacture of kraft paper that has cut the domestic market for the Canadian product in half. The Canadian industry is fully aware of the threat to their newsprint exports if Dr. Herty's experiments succeed in further reducing the cost of converting young pine into sulphite. Dr. Herty's research at the Savannah laboratory has been extended to include the manufacture of book, magazine, absorbent, bond, glazed, rotogravure and coated papers, also alpha cellulose as a base for rayon.

German Chemist Reports Conversion Of Phenol Into Anilin

FROM OUR BERLIN CORRESPONDENT

IN connection with the production of heavy water a report by W. Uhlman, the Department of Physical Chemistry of the Institute of Technology of Dresden states, that water from the acid of an old storage battery at the institute, which had been replenished for about eight years only by filling with distilled water, had been examined. It was found that its density was higher than that of common water, the specific gravity being 1.000033, corresponding to 1 part of H^2 (deuterium) for about 3,000 parts of H^1 (hydrogenium). A concentration of the heavy water isotope may also be effected by the sublimation of ice and snow.

Synthesis of liquid hydrocarbons by catalytic hydrogenation of carbon monoxide at regular pressure (according to F. Fischer and Tropsch) has been further developed during the last year so that it is now possible really to visualize the application of this synthesis on a large scale. It is today possible, with the aid of highly active cobalt or nickel catalysts, which already reach maximum capacity at 200 deg. C., to treat a gas mixture of 1 part of carbon monoxide, and two parts of hydrogen with almost complete conversion of the carbon monoxide, in one pass, and with up to 70 per cent liquid hydrocarbons. While formerly catalysts made by precipitation were used, Fischer has lately succeeded in employing "skeletons" of alloys, which take up only a tenth of the volume occupied by the precipitated catalysts, with almost the same capacity. Nickel-aluminum alloys, as well as alloys of nickel and silicon, cobalt and silicon, and nickel-cobalt-silicon were used, from which the aluminum and the silicon were dissolved by caustic potash, leaving a skeleton of the heavier metals; the skeleton of an alloy with nickel, cobalt, and silicon in ratio 1:1:2 proved most effective. Almost 100 c.c. of liquid hydrocarbons was produced from 1 cu.m. of gas mixture, in one pass. The possibility of reducing the size of the contact apparatus, which has been one of the disadvantages in operation on a large scale, has been demonstrated, on a small scale at least.

Automatic cleaning of spark plugs has been developed by H. Narratiel (German Patent 565,260). It is accomplished by providing catalytic surfaces to prevent deposition of carbon at all points which come in contact with the combustion products. These surfaces consist of metals of the earth or rare earth groups, or metal oxides, such as copper oxide.

Anilin From Phenol

Direct conversion of phenol into anilin has been accomplished by Prof. F. Fischer of Kaiser-Wilhelm Institute for Coal Research. Although only laboratory results are involved, these results are of fundamental technical importance. Phenol is a product which is very difficult to dispose of in time of peace. The present conversion of benzol into anilin by nitration with nitric acid, which now is being produced in Germany by oxidation of synthetic ammonia, presents a round-about way, for the ammonia is first oxidized to nitric acid, again to be reduced to an ammonia radical. Fischer has condensed phenol and ammonia directly to anilin, at a pressure of 10 atm., with a yield of 10 per cent, in the presence of catalysts which split off the water, particularly aluminum oxide. The reaction takes place in the vapor phase at 450-480 deg. C. Already at atmospheric pressure up to 21 per cent of the phenol may be converted into the corresponding primary amine; up to 58-64 per cent of the cresols; and up to 45 per cent of the xylenol.

Of the catalysts examined aluminum oxide has the best effect. At 480 deg. C. a partial demethylating already occurred for the homologues of the anilin. The catalyst lost its action comparatively rapidly, but could be regenerated by oxidation in air of 450-500 deg. C. By the use of low pressures, from 5-10 atm., the yield of amine is considerably increased. A pressure of about 10 atm. (the vapor pressure of ammonia at room temperature) is the most favorable working pressure. Primary amines are mainly obtained. In this manner anilin, m-toluidin, tri-toluidin (from tri-cresol and "waste water amines" were obtained from the corresponding phenols and technical phenol mixtures. Tri-toluidin was successfully added as anti-knock compound to synthetic gasoline (produced from carbon monoxide and hydrogen, by the Fischer and Tropsch method). The importance of the cheap anilin produced by this method is far-reaching. Mention may only be made of the use of anilin as selective solvent in the petroleum industry, for separation of naphthalenes and paraffines.

Program for Semi-Annual Meeting of A.I.Ch.E.

ARRANGEMENTS have practically been completed for the semi-annual meeting of the American Institute of Chemical Engineers which will open at the Waldorf Astoria Hotel on May 14. A technical session will open the meeting, after which the members will sail from West 42d St., with luncheon on board, for the plant of the Standard Oil Co. of N. J. at Elizabethport. The afternoon will be spent in inspection of the hydrogenation and other plant units of the Standard Oil Co. In the evening a banquet will be held at the Waldorf Astoria after which the R.C.A. studios at Rockefeller Center will be visited.

On Tuesday, May 15, there will be breakfast meetings connected with committee activities. The morning will be devoted to a technical session and after lunch, coaches will leave for the Westchester Country Club where the afternoon entertainment will be followed by a dinner dance. Another part of the program for Tuesday afternoon calls for a student technical session with reading of competitive papers.

On Wednesday, May 16, coaches will leave the Waldorf Astoria for New Brunswick with a technical session scheduled at Rutgers University. After luncheon in Rutgers dining hall, coaches will leave for inspection trips to industrial plants.

Among the papers which will be presented at the different sections are: "A Study of Entrainment in a Bubble Cap Distillation Column" by George E. Holbrook and Edwin M. Baker; "Studies in Agitation"—Part IV by A. McLaren White, Edward Brenner, G. A. Phillips, and M. S. Morrison. Part V by A. McLaren White and Edward Brenner; "Continuous Rectification of Binary Mixtures" by J. S. Carey, J. Griswold, W. H. McAdams, and W. K. Lewis; "Industrial Developments in Heat Transfer in Organic Compounds" by R. Lyman Heindel, Jr.; "Fractional Distillation"—Part I by George Granger Brown and Mott Souders, Jr.—Part II by George Granger Brown, Mott Souders, Jr., and William W. Hesler; "Temperature-Time Relations Resulting from the Electrical Heating of the Face of a Slab" by Albert B. Newman; "New Developments in Chemical Engineering Education" by Charles R. Johnson; "Phenolic Plastics in the Chemical Industry" by William H. Adams, Jr.; "Chemical Engineering in the Silk Throwing Industry" by D. S. Chamberlain.

Chemical Developments Reported at A.C.S. Meeting

SPECIAL CORRESPONDENCE

AS everyone who reads the newspapers must know by this time, the St. Petersburg meeting of the American Chemical Society was featured by a paper on gold from sea-water. Not that that ancient dream of the alchemists has suddenly been solved by American chemists, but the idea helped the headline writers to dramatize a more prosaic but extremely interesting chemical engineering achievement of the Ethyl-Dow Chemical Co., namely, the production of bromine from sea-water. Leroy C. Stewart most effectively presented a paper prepared in cooperation with Willard H. Dow. Then followed a striking moving picture showing the operations of the new $3,500,000 plant at Wilmington, N. C.

Other papers at the general meeting on March 26 included Dr. Herty's demonstration of the white paper possibilities of Southern pines, a discussion of chemical securities by Earl L. Smith of the Babson Statistical Organization, and a portrayal of the trend in protective coatings, prepared by E. E. Ware of Sherwin-Williams.

At the Council meeting, President Charles L. Reese reported that the society was again in a sound financial condition and this year will meet its obligations without outside aid or subsidy. The 1934 budget is about $500,000.

A committee headed by Robert T. Baldwin of New York, treasurer of the society, was named to represent the membership in codes affecting the chemical professions. Strong protest was voiced against the inclusion of research in a code for the commercial testing laboratories. Other members of the Code Committee are G. J. Esselen, Boston; Foster D. Snell, New York; Thomas Midgley, Jr. of Worthington, Ohio; Gustav Egloff, Chicago, and Harrison E. Howe, of Washington, D. C.

The Council also voted to appoint a committee to study the problem of creating a federation of chemical societies in the United States. The proposed federation would include in its membership representatives of all of the chemical organizations of the country and would act as their spokesman in both national and international affairs. The proposal was presented by Prof. Marston T. Bogert of Columbia University.

The next meeting of the Society will be held in Cleveland, Ohio, in September. In 1935, it was announced that the Spring meeting will be held in New York and the Fall meeting in San Francisco.

CALENDAR

ELECTROCHEMICAL SOCIETY, and AMERICAN CERAMIC SOCIETY, joint meeting, Asheville, N. C., April 26-28.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, spring meeting, New York City, May 14-16.

AMERICAN SOCIETY FOR METALS, Penn. Inter Chapter meeting, State College, Pa., May 4 and 5.

AMERICAN PETROLEUM INSTITUTE, mid-year meeting, Pittsburgh, Pa., May 22-24.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Atlantic City, June 25-29.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, fall meeting, Portland, Ore., Sept. 10-13.

AMERICAN CHEMICAL SOCIETY, fall meeting, Cleveland, Sept. 10-14.

Synthetic Camphor Gains In Importance

UNTIL recently the world was almost entirely dependent upon Japan for its camphor supplies. In recent years, however, chemists, particularly in the United States and Germany, have perfected synthetic camphor to the point where it is rapidly replacing the natural product in industry, according to the Department of Commerce.

Today the United States is producing approximately one-third of requirements in laboratories, using turpentine as raw material. Three years ago when natural camphor was higher in price, three-fourths of our needs were produced in chemical retorts. In addition, considerable quantities of the synthetic product is imported from foreign countries, chiefly Germany. Imports in 1933 reached 893,000 lb., valued at $220,409.

Imports of natural camphor, both crude and refined, in 1933 totalled 3,608,000 lb., valued at $890,100. Imports of the natural product have declined rapidly, both in value and quantity, as the domestic production of synthetic camphor has increased.

Imports of the natural product in 1919 totalled 4,488,000 lb.; the crude being invoiced at 92c. per lb. and the refined at $1.70. By 1929 imports had increased to 5,594,000 lb. after a ten-year period of fluctuation but the invoice price had declined to 38c. per lb.

FACTORY CONSUMPTION OF PRIMARY ANIMAL AND VEGETABLE FATS AND OILS, BY CLASSES OF PRODUCTS, CALENDAR YEAR 1933

(Quantities in thousands of pounds)

KIND	TOTAL	Compounds and Vegetable Shortenings	Oleomargarine	Other Edible Products	Soap	Paint and Varnish	Linoleum and Oilcloth	Printing Inks	Miscellaneous Products	Loss Including Foots
Total	3,514,641	972,142	198,794	247,753	1,311,263	297,560	69,938	13,419	239,072	164,700
Cottonseed oil	1,114,846	852,843	17,997	121,558	6,967	9	.....	14	2,772	112,686
Peanut oil	8,872	3,330	2,635	1,269	529	1	.....	.....	36	1,072
Coconut oil	583,826	7,117	150,096	69,333	322,264	39	.....	2	2,642	32,333
Corn oil	43,946	1,128	341	27,893	3,638	213	12	.....	3,749	6,972
Soybean oil	22,958	489	7	460	4,235	8,568	5,641	65	2,626	867
Olive oil, edible	2,139	.....	.....	1,861	61	.....	.....	.....	217	.....
Olive oil, inedible	10,217	.....	.....	.....	2,001	.....	.....	.....	8,216	.....
Sulphur oil or olive foots	32,970	.....	.....	.....	31,878	2	.....	.....	1,090	.....
Palm kernel oil	15,962	.....	.....	7,757	6,278	.....	.....	.....	69	1,858
Rapeseed oil	7,698	.....	.....	.....	39	23	18	.....	7,618	.....
Linseed oil	241,325	.....	.....	.....	980	192,959	33,015	10,863	3,508	.....
China wood oil	91,549	.....	.....	.....	5	76,714	11,746	1,523	1,561	.....
Perilla oil	14,186	.....	.....	.....	.....	6,529	5,826	419	1,412	.....
Castor oil	19,486	.....	.....	.....	2,090	2,072	341	53	14,930	.....
Palm oil	232,619	21,116	544	681	187,962	29	.....	2	*16,660	5,625
Sesame oil	13,834	7,371	.....	4,800	758	.....	.....	.....	35	870
Sunflower oil	13,885	2,469	.....	2,535	7,889	175	116	.....	172	529
Other vegetable oils	2,021	.....	.....	.....	176	1,283	.....	.....	562	.....
Lard	17,485	3,171	8,959	4,810	.....	.....	.....	5	301	239
Edible animal stearin	25,421	17,105	3,120	3,402	362	.....	.....	.....	1,432	.....
Oleo oil	19,061	294	15,095	703	112	13	.....	2	2,842	.....
Tallow, edible	51,447	46,437	.....	691	2,389	.....	.....	1	1,734	195
Tallow, inedible	566,731	.....	.....	.....	508,824	112	.....	6	57,654	135
Grease	205,520	.....	.....	.....	124,743	44	.....	349	79,953	431
Neat's-foot oil	4,280	.....	.....	.....	20	20	.....	.....	4,197	43
Marine animal oils	46,110	.....	.....	.....	44,895	2	.....	2	1,211	.....
Fish oils	106,247	9,272	.....	.....	52,168	8,753	13,223	113	21,873	845

*Includes 13,025 thousand reported by the tin and terne plate industry.

NAMES IN THE NEWS

L. N. BENT has been elected vice-president and member of the executive committee of the Hercules Powder Co. A. B. Nixon became general manager of the naval stores department when vacated by Mr. Bent. The new naval stores head joined the company after graduating from Purdue University in 1915. For the past six years he has been general manager of the cellulose products department. In 1932 he was elected a member of the board of directors.

MAHLON G. MILLIKEN has been selected as general manager of the cellulose products department of the Hercules Powder Co. Mr. Milliken goes to Wilmington from Parlin, N. J., where he has been superintendent of the company's nitrocellulose Union plant.

E. F. THOENGES, formerly assistant superintendent at the Parlin, N. J., plant of the Hercules Powder Co., has been appointed superintendent.

IRVING LANGMUIR, associate director of the research laboratory of the General Electric Co., has been appointed honorary chancellor of Union College, Schenectady, N. Y., for the current year. The announcement was made by Acting Pres. Edward E. Ellery of the college.

H. D. JAMES, control expert and long a consulting engineer of the Westinghouse Electric and Manufacturing Co., has opened an engineering consulting service specializing in industrial and building problems.

EDWIN B. NEWTON of the chemical research staff of the B. F. Goodrich Co., is to leave soon for Singapore to engage in studies of latex and crude rubber preparation in the Far East. He has been associated, from the beginning, in the development of the anode process for producing rubber articles directly from latex.

JOHN JACOB ABEL, of Johns Hopkins Medical School, has been announced as the recipient of the 1934 Kober medal for outstanding achievement in scientific research. It will be recalled that Dr. Abel has received several other prizes, including the William Gibbs medal presented yearly by the Chicago Section of the A.C.S.

Arthur Cutts Willard

ARTHUR CUTTS WILLARD has been honored with the presidency of the University of Illinois. After completing a course in chemical engineering at Massachusetts Institute of Technology Dr. Willard joined the chemistry department faculty of the California School of Mechanical Arts. A few years later he became a professor of mechanical engineering at George Washington University. In 1913 he transferred to the University of Illinois. Since 1920 he has been head of the department of mechanical engineering and for the past year acting dean of the college of engineering and acting director of the engineering experiment station.

T. J. HAWLEY, JR., has accepted a position with Naugatuck Chemical Co., Naugatuck, Conn.

C. D. LUKE, formerly with the Standard Oil Development Co., has returned to the Massachusetts Institute of Technology.

E. G. KELLEY is employed by the Calco Chemical Co. at Bound Brook, N. J.

R. A. MACDONNELL is with the Quaker Maid Co., New York, N. Y.

CHARLES H. HERTY is recipient of the 1933 Lucas trophy. This award is given annually by Mr. Arthur Lucas, of Savannah and Atlanta, to the Savannahian who does the most worthwhile thing for the city. It goes to Dr. Herty for his development of the uses of the pine trees in the making of newsprint and other paper.

A. V. H. MORY, for several years assistant director of research in the Bakelite Corp., has resigned the position and is now associated with the General Printing Ink Co., New York.

R. S. FLEMING, director of the research laboratory of the Borden Co., was honored at a banquet on the 30th anniversary of his affiliation with the company and its predecessors.

ROBERT E. PHELAN, general manager of the Hudson Bay Mining & Smelting Co., has been awarded the Inco platinum medal of the Canadian Institute of Mining and metallurgy. The award is for service to Canada's mineral industry.

OBITUARY

EUGENE R. BAILEY, former secretary of the Grasselli Chemical Co. died March 31 after a short illness in Cleveland. He retired in 1928, when the company became part of E. I. du Pont de Nemours & Co. Mr. Bailey was 69 years of age. Born in Cincinnati, he went to Cleveland in 1885 and started working for the chemical company as a shipping clerk.

STANLEY M. WILLIAMS of the chemical staff of the National Oil Products Co., Harrison, N. J., died at his home in East Orange after an illness of a month. He was 55 years old.

FRANCIS PRESTON VENABLE, former president of the University of North Carolina, and an internationally known chemist, died March 17 in a Richmond, Va., sanitarium. He was 78 years old.

Dr. Venable was born in Prince Edward Co., Va., and attended the universities of Virginia, Bonn, Göttingen and Berlin. He had honorary degrees bestowed upon him by Lafayette College, Jefferson College, University of Pennsylvania, University of South Carolina and the University of Alabama. Dr. Venable served the University of North Carolina as professor of chemistry and as president over a period of approximately 50 years. He had served on the Advisory Council of the Chemical Warfare Service and as president of the American Chemical Society.

STEPHEN J. HAUSER, vice-president of the Hauser-Stander Tank Co., Cincinnati, died suddenly on March 12. Mr. Hauser was visiting in St. Petersburg, Fla., at the time of his death.

FRANK J. MCGANNEY, former manager of the Salt Lake territory of Hercules Powder Co., died suddenly at Salt Lake City on March 12.

CHEMICAL ECONOMICS

Although production of chemicals in March was larger than in February, this appears to be due to the larger number of working days as the rate of operations was below that reported for January and February. Evidently schedules are regulated to hold down inventories as some consumers stocked ahead in anticipation of higher prices.

CHEMICAL manufacturers are maintaining a rate considerably higher than that in effect a year ago. There is no attempt however to speed up operations to a point where accumulations in sellers' hands will become heavy. This is made evident from the fact that the rate of productive activities in March was less than that reported for either of the two preceding months. The index numbers for production, based on consumption of electrical power, covering the first quarter of this year are 133.1 for January, 131.6 for February and 132.3 for March.

While the index number for March was higher than that for February, an adjustment based on number of working days establishes a lower rate of activity. Some branches of the industry responded to seasonal influences, notably solvents with the close of the anti-freeze season. In other cases, seasonal influences were slow to develop, for instance, call for chemicals for the paint and varnish industry was rather disappointing in March, although improvement has been reported since the turn of the month.

Favorable reports continue to come from different branches of the chemical industry and from sources which are consumers of chemical products. Automotive output for the first quarter of the year was about double that for the first quarter of 1933 and April schedules, unless interrupted by labor troubles, call for an outturn that will exceed that of any month since early in 1930. Steel production in March is estimated at 47.81 per cent of theoretical capacity compared with 42.57 per cent in February and with 15.5 per cent for March, 1933. Soap makers have experienced an active quarter, with sales in February and March showing much larger gains than had been anticipated. Sales of sulphur for the first quarter were reported to have been close to 25 per cent higher than those for the first quarter of last year. This in part is due to the larger use of sulphuric acid in the fertilizer trade.

Freight car loadings in the second quarter of this year will be 10.7 per cent above actual loadings in the same quarter in 1933, according to estimates compiled by the thirteen shippers' regional advisory boards. Each of the thirteen regional boards estimates an increase in loadings for the quarter ending June 30.

In the textile industry, which held up well last year, small gains are reported for this year to date. Silk consumption, which lagged last year, has become more active, but *Textile Organon* reports the March index for rayon deliveries at 344, as compared with 423 for February. The comparison for the first quarter, however, is represented by an average of 385 for 1934 and 282 for 1933.

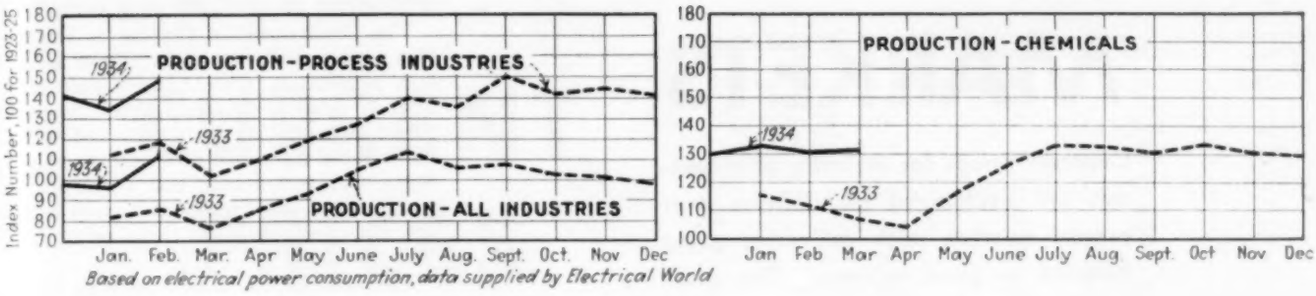
Foreign trade in chemicals and related products has gained appreciably in the year to date. The latest available figures are for February and show that exports for the first two months of this year reached a value of $13,258,519 compared with $10,396,727 for the like period of 1933. This represents an increase of 27.5 per cent and it is noteworthy that gains were recorded in nearly every division. In the industrial chemical group, exports of sodium compounds were 73,690,894 lb. and 62,842,979 lb. for the 1934 and 1933 periods respectively, with soda ash contributing largely to the increase. Nitrate of soda, sulphate of ammonia, and phosphate rock were responsible for the rise in fertilizer exports.

Imports of chemicals in Jan.-Feb. 1934 were valued at $11,363,557 against $7,621,482 for last year or a gain of more than 49 per cent. Creosote oil was prominent in the import total of coal-tar products. Acetic acid, potassium carbonate, ammonium nitrate, and sodium ferrocyanide were prominent in imports in the industrial chemical group.

The accompanying table gives data on activities in leading chemical-consuming industries for the first two months of the year. The comparison with the corresponding months of last year naturally are favorable in view of depressed conditions in industry a year ago but the comparison is valuable inasmuch as it establishes the degree of increase in current industrial operations.

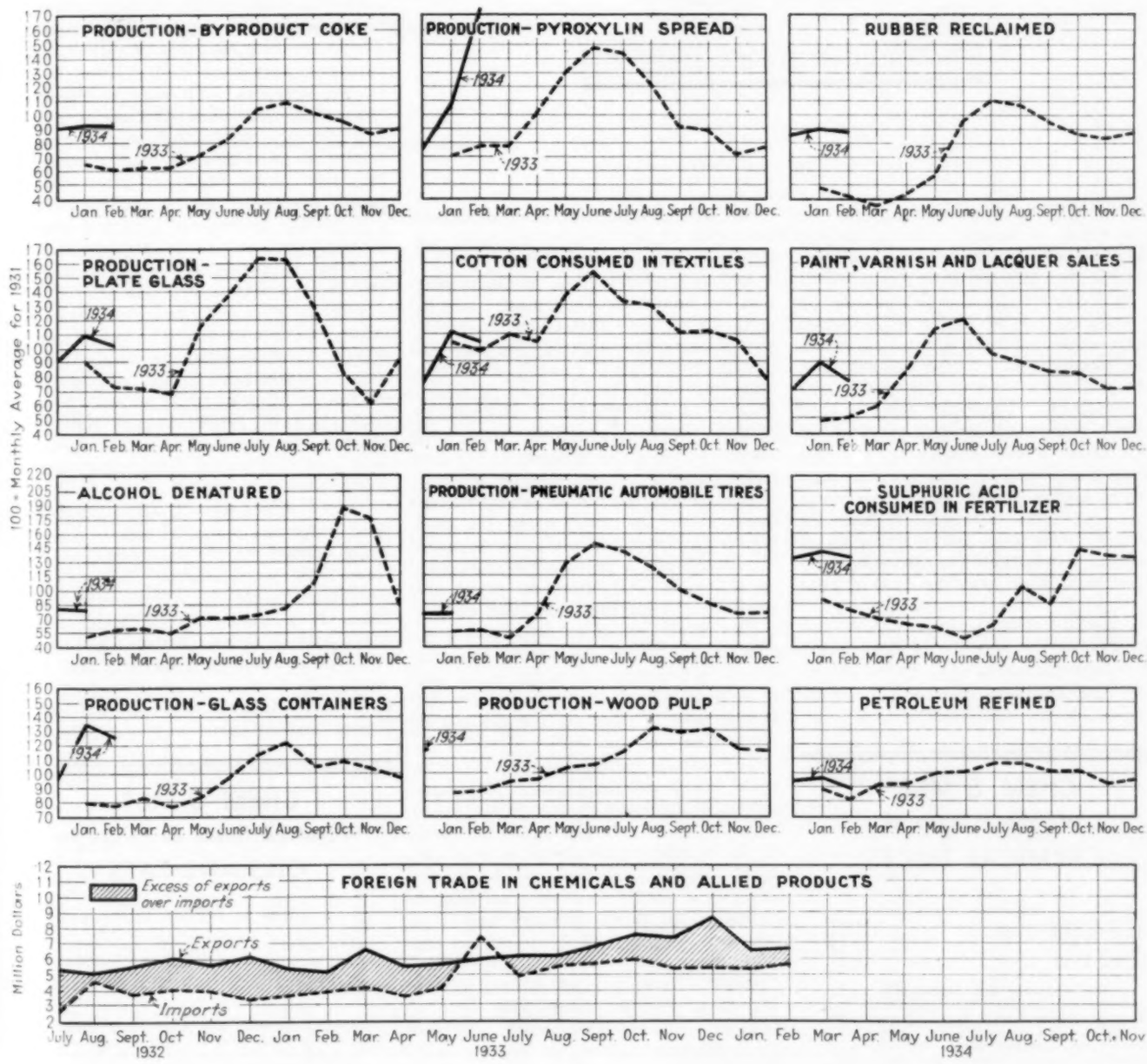
Production and Consumption Data for Chemical-Consuming Industries

	Feb., 1934	Feb., 1933	Jan.-Feb., 1934	Jan.-Feb., 1933	Per Cent of gain Jan.-Feb., 1934
Production					
Automobiles, no.	235,376	106,858	396,462	236,975	67.3
Byproduct coke, 1,000 tons	2,493	1,639	4,969	3,424	45.1
Cellulose-acetate plastics sheets, rods, tubes, 1,000	436	142	794	309	156.9
Nitro-cellulose plastics sheets, rods, tubes, 1,000	1,152	585	2,100	1,178	78.3
Glass containers, 1,000 gr.	2,600	1,585	5,370	3,221	66.7
Plate glass, 1,000 sq.ft.	7,441	4,955	15,048	11,143	35.0
Petroleum refined, 1,000 bbl.	66,470	61,042	137,982	127,145	8.5
Pyroxylin spread, 1,000 lb.	5,278	2,374	8,561	4,495	90.4
Steel barrels, no.	573,391	311,111	1,281,555	652,493	96.4
Sulphuric acid produced in fertilizer trade, tons	139,666	99,825	283,477	214,443	32.2
Rosin, wood, bbl.	46,016	25,583	92,866	56,771	63.6
Turpentine, wood, bbl.	7,892	4,175	15,862	9,150	73.3
Rubber reclaimed, tons	8,934	4,303	18,172	9,286	95.7
Consumption					
Cotton, 1,000 bales	478	441	986	911	8.2
Silk, bales	39,021	32,665	79,963	78,869	1.4
Wool, 1,000 lb.	34,348	33,278	70,316	68,788	2.2
Explosives, sales, 1,000 lb.	25,584	16,510	54,088	34,481	56.9
Paint, varnish, lacquer, sales, $1,000	17,715	11,666	38,359	22,941	67.2
Sulphuric acid in fertilizer trade, tons	149,483	88,180	310,983	189,516	64.1


PRODUCTION - PROCESS INDUSTRIES
PRODUCTION - ALL INDUSTRIES
PRODUCTION - CHEMICALS
1934
1933
Index Number, 100 for 1923-25
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

Based on electrical power consumption, data supplied by Electrical World

TRENDS OF PRODUCTION AND CONSUMPTION


PRODUCTION - BYPRODUCT COKE
PRODUCTION - PYROXYLIN SPREAD
RUBBER RECLAIMED
PRODUCTION - PLATE GLASS
COTTON CONSUMED IN TEXTILES
PAINT, VARNISH AND LACQUER SALES
ALCOHOL DENATURED
PRODUCTION - PNEUMATIC AUTOMOBILE TIRES
SULPHURIC ACID CONSUMED IN FERTILIZER
PRODUCTION - GLASS CONTAINERS
PRODUCTION - WOOD PULP
PETROLEUM REFINED
100 = Monthly Average for 1931
1934
1933
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

FOREIGN TRADE IN CHEMICALS AND ALLIED PRODUCTS
Excess of exports over imports
Exports
Imports
Million Dollars
July Aug. Sept. Oct Nov Dec. Jan Feb. Mar Apr May June July Aug. Sept. Oct. Nov Dec Jan. Feb Mar Apr. May June July Aug. Sept. Oct. Nov
1932
1933
1934

MARKETS

Contract prices for majority of chemicals are unchanged for delivery over second quarter with deliveries going forward in good volume. The price trend, however, is still upward with higher container charges adding to the cost of packaged goods. Control committee set up for naval stores industry with a license to be issued to wood turpentine and rosin branch.

IN SOME cases, contract prices for chemicals as named in the latter part of last year, applied only to delivery over the first quarter of this year. Generally, contracts have been renewed on an unchanged basis for the second quarter. In some instances where bulk prices were repeated, an increase was asked on packaged goods due to the higher cost of containers. The price tone is firm and while fluctuations were reported on both sides of the market in the last month the weight of influence has been toward higher levels and the general trend continues upward. Consuming call for chemicals is fairly active as all consuming industries are operating on a larger scale than was the case a year ago.

Seasonal influences have added considerably to the activity of the market with paint materials, agricultural chemicals, and ammonia receiving more attention. With the exception of zinc oxide where price advances stimulated buying in March, demand for paint materials had be relatively quiet.

Recent publicity given to the production of bromine in this country gives interest to a report that Canadian Industries, Ltd., is investigating the possibilities of the technical production of bromine and iodine from deep-well waters discovered near Maidstone, Belle River, Ontario. It is reported that the bromine content of the water is about 1½ per cent and the iodine content slightly lower.

The control committee set up for the naval stores industry under the marketing agreement with the Government has established a permissible marketing quota of 381,000 units of rosin and turpentine from the 1934-1935 crop.

The marketing quota represents a reduction of 10 per cent from the estimated production of gum rosin and turpentine for the season ending this month, and is effective for the period April 1 to Dec. 31, 1934.

The above quota does not include wood, rosin and turpentine. Representatives of the wood turpentine and rosin industry have recently conferred with A. A. A. officials for the purpose of determining the basis for and the provisions of a license to cover that branch of the naval stores industry and it is reported licenses will be issued in the near future.

Reports from abroad state that the agreement reached some time ago by producers of phosphate rock whereby the consuming markets of Europe were allocated, is on a basis which gives United States producers 16 per cent of the business based on a total European distribution of 3,000,000 tons annually.

The Department of Commerce refers to a report published in an official Russian publication which states that the Soviet Union possesses the largest potash deposits in the world, and with the help of an army of workers, engineers and technicians has constructed and put in operation a potash plant with first class technical and chemical equipment.

The first potash mine was built with complete mechanical equipment, and is expected to turn out 4,500 tons of crude salts daily, with a present daily production of 2,200 tons, to be increased soon to 3,000. The latter figure has already been reached, the production in December having been 62,000 tons, and for some days in that month as high as 3,000. A complete underground town is being built at a depth of 250 meters. There are 13 kilometers of tunnels and passages, with electrified railroad lines, cranes, scrapers, and other mechanical appliances. At this depth there is a station for the cars, and a mechanical workshop. Self-dumping cars discharge the salts into bunkers, after being hauled to position by an endless chain. The miners' community lives and works underground, served by electric trains running in passages cut through the blue-white sylvinite deposits.

The salts mined are ground in a crusher, then transferred to the refinery, which is constructed to handle 3,500 tons of crude salts a day, and to turn out 600 to 650 tons of 85 per cent potassium chloride. At the present time the plant is treating 2,000 to 2,200 tons a day, the record for December being 48,500 tons.

Thirty kilometers from Solikamsk, near Berezniki, a second potash mine is being opened up, for production on the same scale as the first. This will be completed during the second Five Year Plan. It is being built by Soviet engineers and workers without the benefit of foreign technical leadership and advice. The first shaft of the new mine has been driven, through the deep frozen surface layer, to the salt strata.

CHEM. & MET.
Weighted Index of CHEMICAL PRICES

Base = 100 for 1927

This month	**88.93**
Last month	88.86
April, 1933	84.30
April, 1932	85.01

Price changes for chemicals were infrequent during the past month. Lower levels were reached by calcium arsenate and lead arsenate. Tin salts, tartaric acid, and turpentine maintained higher averages and the index number was slightly advanced.

CHEM. & MET.
Weighted Index of Prices for OILS AND FATS

Base = 100 for 1927

This month	**57.13**
Last month	56.30
April, 1933	42.01
April, 1932	41.55

Some of the oils showed a tendency to back and fill but crude cottonseed oil and glycerin were firmer and influenced the general price level. Animal fats held a fairly steady position throughout the month.

CURRENT PRICES

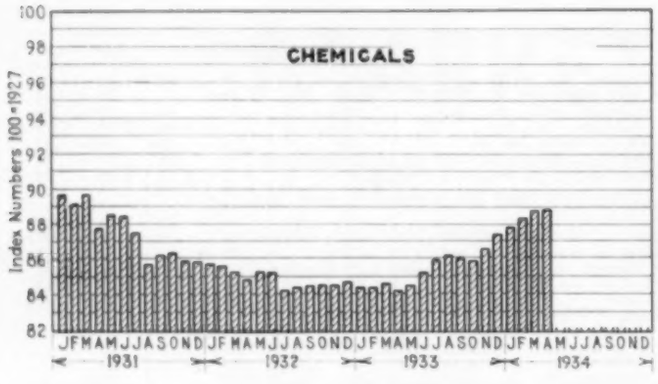
The following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to April 12.

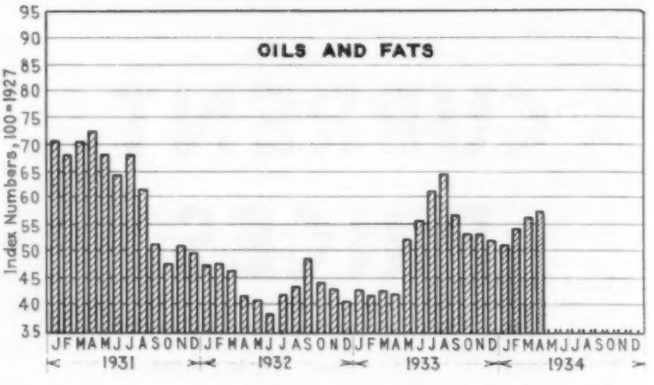
Industrial Chemicals

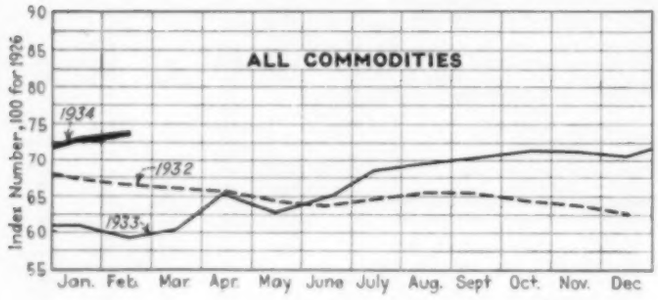
	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.11 –$0.11½	$0.11 –$0.11½	$ .08½–$0.09
Acid, acetic, 28%, bbl., cwt.	2.90 – 3.15	2.90 – 3.15	2.65 – 2.90
Glacial 99%, drums	10.02 –10.27	10.02 –10.27	8.89 –
U. S. P. reagent, c'bys.	10.52 –10.77	10.52 –10.77	9.14 – 9.39
Boric, bbl., lb.	.04½– .05	.04½– .05	.04¼– .05
Citric, kegs, lb.	.28 – .31	.28 – .31	.29 – .31
Formic, bbl., lb.	.11 – .11½	.11 – .11½	.10 – .11
Gallic, tech., bbl., lb.	.60 – .65	.60 – .65	.50 – .55
Hydrofluoric 30% carb., lb.	.07 – .07½	.07 – .07½	.06 – .07
Latic, 44%, tech., light, bbl., lb.	.11½– .12	.11½– .12	.11½– .12
22%, tech., light, bbl., lb.	.05½– .06	.05½– .06	.05½– .06
Muriatic, 18° tanks, cwt.	1.00 – 1.10	1.00 – 1.10	1.00 – 1.10
Nitric, 36°, carboys, lb.	.05 – .05½	.05 – .05½	.05 – .05¼
Oleum, tanks, wks., ton.	18.50 –20.00	18.50 –	18.50 –20.30
Oxalic, crystals, bbl., lb.	.11½– .12½	.11½– .12½	.11 – .12
Phosphoric, tech., c'bys., lb.	.09 – .10	.09 – .10	.08½– .09
Sulphuric, 60°, tanks, ton.	11.00 –11.50	11.00 –11.50	11.00 –11.50
Sulphuric, 66°, tanks, ton.	15.50 –	15.50 –	15.50 –
Tannic, tech., bbl., lb.	.23 – .35	.23 – .35	.23 – .35
Tartaric, powd., bbl., lb.	.26 – .26½	.25½– .26	.20 – .21
Tungstic, bbl., lb.	1.40 – 1.50	1.40 – 1.50	1.40 – 1.50
Alcohol, ethyl, 190 p'f., bbl., gal.	4.15½–	4.15½–	2.53½–
Alcohol, Butyl, tanks, lb.	.095–	.095–	.113–
Alcohol, Amyl	–	–	–
From Pentane, tanks, lb.	.15 –	.15 –	.143–
Denatured, 190 proof			
No. 1 special dr., gal.	.346–	.346–	.343–
No. 5, 188 proof, dr., gal.	.34 –	.34 –	.383–
Alum, ammonia, lump, bbl., lb.	.03 – .04	.03 – .04	.03 – .04
Chrome, bbl., lb.	.04½– .05	.04½– .05	.04½– .05
Potash, lump, bbl., lb.	.03 – .04	.03 – .04	.03 – .04
Aluminum sulphate, com., bags, cwt.	1.35 – 1.50	1.35 – 1.50	1.25 – 1.40
Iron free, bg., cwt.	1.90 – 2.00	1.90 – 2.00	1.90 – 2.00
Aqua ammonia, 26°, drums lb.	.02½– .03	.02½– .03	.02½– .03
tanks, lb.	.02½– .02¾	.02½– .02¾	.02½– .02¾
Ammonia, anhydrous, cyl., lb.	.15½– .16	.15½– .16	.15¾– .15¾
tanks, lb.	.04½–	.04½–	.05 –
Ammonium carbonate, powd. tech., casks, lb.	.08 – .12	.08 – .12	.08 – .12
Sulphate, wks., cwt.	1.25 –	1.25 –	1.00 –
Amylacetate tech., tanks, lb., gal	.14½–	.14½–	.135–
Antimony Oxide, bbl., lb.	.08½– .10	.08½– .10	.07 – .08
Arsenic, white, powd., bbl., lb.	.04 – .04½	.04 – .04½	.04 – .04½
Red, powd., kegs, lb.	.15 – .15¾	.14 – .14¾	.09 – .10
Barium carbonate, bbl., ton.	56.50 –58.00	56.50 –58.00	56.50 –58.00
Chloride, bbl., ton.	74.00 –75.00	74.00 –75.00	63.00 –65.00
Nitrate, cask, lb.	.08½– .09	.08½– .09	.07½– .07½
Blanc fixe, dry, bbl., lb.	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f.o.b., wks., drums, cwt.	1.85 – 2.00	1.85 – 2.00	1.75 – 2.00
Borax, grain, bags, ton.	40.00 –45.00	40.00 –45.00	40.00 –45.00
Bromine, cs., lb.	.36 – .38	.36 – .38	.36 – .38
Calcium acetate, bags.	3.00 –	3.00 –	2.50 –
Arsenate, dr., lb.	.06 – .07	.07 – .08	.05½– .06½
Carbide drums, lb.	.05 – .06	.05 – .06	.05 – .06
Chloride, fused, dr., wks., ton.	17.50 –	17.50 –	18.00 –
flake, dr., wks., ton.	19.50 –	19.50 –	21.00 –
Phosphate, bbl., lb.	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb.	.05½– .06	.05½– .06	.05 – .06
Tetrachloride drums, lb.	.05½– .06	.05½– .06	.06½– .07
Chlorine, liquid, tanks, wks., lb.	.0185–	.0185–	.01½–
Cylinders	.05½– .06	.05½– .06	.05½– .06
Cobalt oxide, cans, lb.	1.35 – 1.40	1.35 – 1.40	1.25 – 1.35
Copperas, bgs., f.o.b. wks., ton.	14.00 –15.00	14.00 –15.00	14.00 –15.00
Copper carbonate, bbl., lb.	.08½– .16	.08½– .16	.07 – .16
Cyanide, tech., bbl., lb.	.39 – .44	.39 – .44	.39 – .44
Sulphate, bbl., cwt.	3.85 – 4.00	3.75 – 4.00	3.00 – 3.25
Cream of tartar, bbl., lb.	.18½– .19	.18 – .18½	.14½– .15
Diethylene glycol, dr., lb.	.14 – .16	.14 – .16	.14 – .16
Epsom salt, dom., tech., bbl., cwt.	2.10 – 2.15	2.10 – 2.15	1.70 – 2.00
Imp., tech., bags, cwt.	2.00 – 2.10	2.00 – 2.10	1.15 – 1.25
Ethyl acetate, drums, lb.	.08½–	.08½–	.08½–
Formaldehyde, 40%, bbl., lb.	.06 – .07	.06 – .07	.06 – .07
Furfural, dr., contract, lb.	.10 – .17½	.10 – .17½	.10 – .17½
Fusel oil, crude, drums, gal.	.75 –	.75 –	1.10 – 1.20
Refined, dr., gal.	1.25 – 1.30	1.25 – 1.30	1.80 – 1.90
Glaubers salt, bags, cwt.	1.00 – 1.10	1.00 – 1.10	1.00 – 1.10
Glycerine, c.p., drums, extra, lb.	.12½– .13	.12 – .12½	.10½– .10½
Lead:			
White, basic carbonate, dry casks, lb.	.06½–	.06½–	.06 –
White, basic sulphate, sck., lb.	.06 –	.06 –	.06 –
Red, dry, sck., lb.	.08 –	.07½–	.06½–
Lead acetate, white crys., bbl., lb.	.10½– .11	.10½– .11	.10 – .11
Lead arsenate, powd., bbl., lb.	.09 – .13	.10 – .13	.09 – .13
Lime, chem., bulk, ton.	8.50 –	8.50 –	8.50 –
Litharge, pwd., csk, lb.	.07 –	.06½–	.05½–
Lithophone, bags, lb.	.04½– .05	.04½– .05	.04½– .05
Magnesium carb., tech., bags, lb.	.06 – .06½	.06 – .06½	.05½– .06
Methanol, 95%, tanks, gal.	.33 –	.33 –	.33 –
97%, tanks, gal.	.34 –	.34 –	.34 –
Synthetic, tanks, gal.	.35½–	.35½–	.35½–
Nickel salt, double, bbl., lb.	.11½– .12	.11½– 12	.11 – .11½
Orange mineral, csk., lb.	.10½–	.10½–	.09½–
Phosphorus, red, cases, lb.	.45 – .46	.45 – .46	.42 – .44
Yellow, cases, lb.	.28 – .32	.28 – .32	.28 – .32
Potassium bichromate, casks, lb.	.07½– .08½	.07½– .08½	.07 – .08
Carbonate, 80-85%, calc. csk., lb	.07 – .07½	.07 – .07½	.05 – .06
Chlorate, powd., lb.	.09½– .10	.09½– .10	.08 – .08½
Hydroxide (c'stic potash) dr., lb.	.07½– .07½	.07½– .07½	.06½– .06½
Muriate, 80% bgs., ton.	37.15 –	37.15 –	37.15 –
Nitrate, bbl., lb.	.05½– .06	.05½– .06	.05½– .06
Permanganate, drums, lb.	.18½– .19	.18½– .19	.16 – .16½
Prussiate, yellow, casks, lb.	.18 – .19	.18 – .19	.16½ – .17
Sal ammoniac, white, casks, lb.	.04½– .05	.04½– .05	.04½– .05
Salsoda, bbl., cwt.	1.00 – 1.05	1.00 – 1.05	.90 – .95
Salt cake, bulk, ton.	13.00 –15.00	13.00 –15.00	13.00 –15.00
Soda ash, light, 58%, bags, contract, cwt.	1.23 –	1.23 –	1.15 –
Dense, bags, cwt.	1.25 –	1.25 –	1.17½–
Soda, caustic, 76%, solid, drums, contract, cwt.	2.60 – 3.00	2.60 – 3.00	2.50 – 2.75
Acetate, works, bbl., lb.	.04½– .05	.04½– .05	.04½– .05
Bicarbonate, bbl., cwt.	1.85 – 2.00	1.85 – 2.00	1.85 – 2.00
Bichromate, casks, lb.	.05½– .06½	.05½– .06½	.044– .05
Bisulphate, bulk, ton.	14.00 –16.00	14.00 –16.00	14.00 –16.00
Bisulphite, bbl., lb.	.03 – .04	.03 – .04	.03½– .04
Chlorate, kegs, lb.	.06½– .06½	.06½– .06½	.05½– .07½
Chloride, tech., ton.	12.00 –14.75	12.00 –14.75	12.00 –14.00
Cyanide, cases, dom., lb.	.15½– .16	.15½– .16	.15½– .16
Fluoride, bbl., lb.	.07½– .08	.07½– .08	.07 – .08
Hyposulphite, bbl., lb.	2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt.	3.25 – 3.40	3.25 – 3.40	3.25 – 3.40
Nitrate, bags, cwt.	1.35 –	1.35 –	1.295–
Nitrite, casks, lb.	.07½– .08	.07½– .08	.07½– .08
Phosphate, dibasic, bbl., lb.	.021– .023	.021– .023	.018– .02
Prussiate, yel. drums, lb.	.11½– .12	.11½– .12	.11½– .12
Silicate (40° dr.) wks. cwt.	.80 – .85	.80 – .85	.70 – .75
Sulphide, fused, 60-62%, dr., lb.	.02½– .03½	.02½– .03	.02½– .03
Sulphite, cyrs., bbl., lb.	.02½– .02½	.02½– .02½	.03 – .03½
Sulphur, crude at mine, bulk, ton	18.00 –	18.00 –	18.00 –
Chloride, dr., lb.	.03½– .04	.03½– .04	.03½– .04
Dioxide, cyl., lb.	.07 – .07½	.07 – .07½	.06½– .07
Flour, bag, cwt.	1.60 – 3.00	1.55 – 3.00	1.55 – 3.00
Tin Oxide, bbl. lb.	.57 –	.55 –	.29½–
Crystals, bbl., lb.	.40½–	.38½–	.25½–
Zinc chloride, gran., bbl., lb.	.05½– .06	.05½– .06	.06½– .06½
Carbonate, bbl., lb.	.09½– .11	.09½– .11	.10½– .11
Cyanide, dr., lb.	.38 – .42	.38 – .42	.38 – .42
Dust, bbl., lb.	.07 – .07½	.07 – .07½	.04½– .05
Zinc oxide, lead free, bag, lb.	.06½–	.06½–	.05½–
5% lead sulphate, bags, lb.	.06½–	.06½–	.05½–
Sulphate, bbl., cwt.	3.00 – 3.25	3.00 – 3.25	3.00 – 3.25

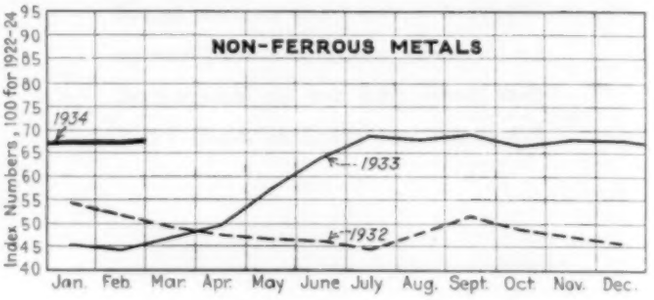
Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.09½–$0.10	$0.09½–$0.10	$0.08½–$0.09
Chinawood oil, bbl., lb.	.08½–	.08 –	.05 –
Coconut oil, Ceylon, tanks, N. Y. lb.	.02½–	.02½–	.03 –
Corn oil crude, tanks, (f.o.b. mill), lb	.04½–	.04½–	.03½–
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.04½–	.04½–	.02½–
Linseed oil, raw car lots, bbl., lb.	.09⅗	.09⅗	.074–
Palm, Lagos, casks, lb.	.03½–	.03½–	.02½–
Palm Kernel, bbl., lb.	.04½–	.04½–	.04½–
Peanut oil, crude, tanks (mill), lb.	.05 –	.04½–	.03½–
Rapeseed oil, refined, bbl., gal.	.42 – .43	.44 – .45	.37 – .38
Soya bean, tank, lb.	.06½–	.06½–	–
Sulphur (olive foots), bbl., lb.	.06½–	.06½–	.04½–
Cod, Newfoundland, bbl., gal.	nom.	nom.	.21 – .22
Menhaden, light pressed, bbl., lb.	.05½–	.05½–	.03½–
Crude, tanks (f.o.b. factory), gal.	.20 –	.15 –	.09 –
Grease, yellow, loose, lb.	.03½–	.03½–	.02½–
Oleo stearine, lb.	.05½–	.05½–	.03½–
Red oil, distilled, d.p. bbl., lb.	.07 –	.07 –	.06 –
Tallow, extra, loose, lb.	.03½–	.03½–	.02½–









Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl., lb	.80 - .85	.80 - .85	.80 - .85
Alpha-naphthylamine, bbl., lb	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb	.14½- .15	.14½- .15	.14½- .15
Aniline salts, bbl., lb	.24 - .25	.24 - .25	.24 - .52
Benzaldehyde, U.S.P., dr., lb	1.10 - 1.25	1.10 - 1.25	1.10 - 1.25
Benzidine base, bbl., lb	.65 - .67	.65 - .67	.65 - .67
Benzoic acid, U.S.P., kgs, lb	.48 - .52	.48 - .52	.48 - .52
Benzyl chloride, tech., dr., lb	.30 - .35	.30 - .35	.30 - .35
Benzol, 90%, tanks, works, gal	.19 - .20	.20½- .21	.22 - .23
Beta-naphthol, tech., drums, lb	.22 - .24	.22 - .24	.22 - .24
Cresol, U.S.P., dr., lb	.11 - .11½	.11 - .11½	.10½- .11
Cresylic acid, 97%, dr., wks., gal	.50 - .51	.50 - .51	.42 - .45
Diethylaniline, dr., lb	.55 - .58	.55 - .58	.55 - .58
Dinitrophenol, bbl., lb	.29 - .30	.29 - .30	.29 - .30
Dinitrotoluen, bbl. lb	.16 - .17	.16 - .17	.16 - .17
Dip oil 25% dr., gal	.23 - .25	.23 - .25	.23 - .25
Diphenylamine, bbl., lb	.38 - .40	.38 - .40	.38 - .40
H-acid, bbl., lb	.65 - .70	.65 - .70	.65 - .70
Naphthalene, flake, bbl., lb	.06 - .07	.06 - .07	.04½- .05
Nitrobenzene, dr., lb	.08½- .09	.08½- .09	.08½- .10
Para-nitraniline, bbl., lb	.51 - .55	.51 - .55	.51 - .55
Phenol, U.S.P., drums, lb	.14½- .15	.14½- .15	.14½- .15
Picric acid, bbl., lb	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr., gal	1.10 - 1.15	1.10 - 1.15	.90 - .95
Resorcinal, tech., kegs, lb	.65 - .70	.65 - .70	.65 - .70
Salicylic acid, tech., bbl., lb	.40 - .42	.40 - .42	.40 - .42
Solvent naphtha, w.w., tanks, gal	.26 -.....	.26 -.....	.26 -.....
Tolidine, bbl., lb	.88 - .90	.88 - .90	.88 - .90
Toluene, tanks, works, gal	.30 -.....	.30 -.....	.30 -.....
Xylene, com., tanks, gal	26 -.....	.26 -.....	.26 -.....

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton	$22.00-$25.00	$22.00-$25.00	$22.00-$25.00
Casein, tech., bbl., lb	.12½- .13	.11½- .13	.07 - .10½
China clay, dom., f.o.b. mine, ton	8.00 -20.00	8.00 -20.00	8.00 -20.00
Dry colors:			
Carbon gas, black (wks.), lb	.04 - .20	.04 - .20	.02½- .20
Prussian blue, bbl., lb	.35½- .37	.35 - .36	.35 - .36
Ultramine blue, bbl., lb	.06 - .32	.06 - .32	.06 - .32
Chrome green, bbl., lb	.26 - .27	.26 - .27	.27 - .30
Carmine red, tins, lb	4.00 - 4.40	4.00 - 4.40	3.90 - 4.50
Para toner, lb	.80 - .85	.80 - .85	.75 - .80
Vermilion, English, bbl., lb	1.60 - 1.63	1.58 - 1.60	1.10 - 1.30
Chrome yellow, C. P., bbl., lb	.15 - .16	.15 - .15½	.15 - .15½
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb	.07 - .08½	.07 - .08½	.07 - .08½
um copal Congo, bags, lb	.09 - .10	.08 - .09	.06 - .08
Manila, bags, lb	.09 - .10	.09 - .10	.16 - .17
Damar, Batavia, cases, lb	.15½- .16	.15 - .15½	.16 - .16½
Kauri No. 1 cases, lb	.20 - .25	.20 - .25	.45 - .48
Kieselguhr (f.o.b. N.Y.), ton	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc, ton	50.00 -.....	50.00 -.....	40.00 -.....
Pumice stone, lump, bbl., lb	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb	.03 - .40	.03 - .40	.03 - .35
Rosin, H., bbl	6.25 -.....	6.45 -.....	3.90 -.....
Turpentine, gal	.58½-.....	.62 -.....	.42 -.....
Shellac, orange, fine, bags, lb	.28 - .29	.26 - .27	.19 - .20
Bleached, bonedry, bags, lb	.29 - .31	.29 - .31	.18 - .19
T. N. bags, lb	.21 - .22	.21 - .22	.08½- .09
Soapstone (f.o.b. Vt.), bags, ton	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton	8.00 - 8.50	8.00 - 8.50	8.00 - 8.50
300 mesh (f.o.b Ga.), ton	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N Y.), ton	13.75 -.	13.75 -.....	13.75 -.....

INDUSTRIAL NOTES

ALLIS-CHALMERS MFG. CO., Milwaukee, has appointed B. F. Bilsland manager of its Chicago office and A. J. Cooper assistant manager of the New York office.

THE UNITED STATES PIPE AND FOUNDRY CO., Burlington, N. J., has opened offices in the Earle Bldg., Washington, D. C., in charge of S. E. Linderman. The company also opened offices in the Consolidated Gas Bldg., Boston, in charge of Carl N. Brown, formerly Kansas City sales agent. Mr. Brown will be succeeded at the Kansas City office by R. C. Lemert, formerly of the Birmingham, Ala., office.

AMERICAN CYANAMID CO., and subsidiaries, including the Chemical Construction Corp., moved its New York offices on April 15 to 30 Rockefeller Plaza.

THE DURIRON CO., Dayton, Ohio, has transferred G. A. Baker, formerly manager of its Buffalo office, to the general offices. Col. M. W. Smith is temporarily in charge of the Buffalo office.

THE HAGAN CORP., Pittsburgh, announces the appointment of E. W. Wagenseil to the newly created position of general sales manager of the Hagan Corp. and its subsidiaries—The Buromin Co., Hall Laboratories, Inc., and Calgon, Inc. The latter company has just been organized to market Calgon products.

ROBINS CONVEYING BELT CO., New York, has appointed Fred Bathke, 1957 University Place, St. Paul, as sales representative in Minnesota, western Wisconsin, and northwestern Michigan. Raymond Church, Box 114, Pleasant Ridge Station, Cincinnati, will represent the company in southwestern Ohio, southern Indiana, and southeastern Indiana.

GLYCO PRODUCTS CO., Brooklyn, has named The Technical Service Bureau, 6805 N. Clark St., Chicago, as its representative in Illinois, Wisconsin, and northern Indiana.

DOW CHEMICAL CO. has moved its New York offices to 30 Rockefeller Plaza.

H. O. SWOBODA, INC., Pittsburgh, has appointed Maxfield Pease, 4614 Prospect Ave., Cleveland, as sales representative in northern Ohio. Mr. Pease succeeds E. H. Merrick who died in January.

INGERSOLL-RAND CO., New York, announces that Batt L. Spain has joined the company as manager of the turbo-blower department. Mr. Spain was with the General Electric Co. for the last 24 years and his transfer is the result of the acquisition of the turbo-blower business of General Electric by Ingersoll-Rand.

SOLVAY SALES CORP., on May 1, will move its offices in Philadelphia to 12 So. 12th St.

NEW CONSTRUCTION

Where Plants Are Being Built in Process Industries

	Current Projects		Cumulative to Date	
	Proposed Work and Bids	Contracts Awarded	Proposed Work and Bids	Contracts Awarded
New England	$233,000	$56,000	$737,000	$85,000
Middle Atlantic	992,000	1,175,000	1,916,000	728,000
Southern	.....	.....	11,459,000	1,055,000
Middle West	173,000	628,000	1,694,000	915,000
West of Mississippi	11,188,000	28,000	14,343,000	198,000
Far West	82,000	56,000	1,017,000	472,000
Canada	35,000	53,000	1,558,000	.....
Total	$12,703,000	$1,996,000	$32,724,000	$3,453,000

PROPOSED WORK BIDS ASKED

Alcohol Plant—Shell Oil Co., Shell Oil Bldg., San Francisco, Calif., is having plans prepared by its engineering department for an alcohol plant at Martinez, Calif.

Ammunition Depot—War Department, Washington, D. C., contemplates the construction of four or six reinforced-concrete ammunition depots at Camp Stanley, San Antonio, Tex. $1,000,000.

Blackboard Factory — Pennsylvania Natural Slate Blackboard Co., Slatington, Pa., plans the construction of a new plant to replace the one destroyed by fire. $80,000.

Distillery—A. M. Hanauer, c/o Hamburger Distillery, L. E. Wirth, Supt., Brownsville, Pa., plans complete rehabilitation of distillery here, including installation of new machinery and equipment. $150,000.

Distillery—Honey Creek Distilling Co., c/o Middle West Engineering Co., 3504 Troost Ave., Kansas City, Mo., plans to recondition its distillery.

Distillery—Old Medford Rum Distillery, 83 Newbury St., Boston, Mass., plans additions and alterations to its distillery and warehouse on Hall St. New equipment will be installed. Leon Hysen, c/o Owner, is architect.

Evaporating Plant — Green Springs Mineral Water Crystals, Inc., c/o Stanley Wolfe, Pres., Fremont, O., plans the construction of a 1 story, brick and steel evaporating plant at Green Springs, O. $35,000.

Gas Plant—City, Aledo, Ill., contemplates the construction of an artificial gas plant and distribution system. J. A. McBride, 2639 Locust St., St. Louis, Mo., Engr. $98,000.

Gas Plant—City, Kansas City, Mo., c/o M. S. Murray, Director of Public Works, contemplates the construction of a municipal gas plant and distribution system. Has applied to the Public Works Administration for a loan and grant of $10,130,000.

Gas Plant—City, Luverne, Minn., will hold election April 24 to vote on $30,000 bonds for construction of gas plant.

Laboratory—Board of Education, Farrell, Pa., plans the construction of a 3 story high school to include science laboratories. $500,000.

Laboratory—Commonwealth of Massachusetts, Department of Mental Diseases, State House, Boston, Mass., soon lets contract for a laboratory and mortuary building at the State Hospital at Dorchester, Mass. Wendell, Taylor & Co., 142 Berkeley St., Boston, Archts. $55,000.

Laboratory—Ohio College of Chiropy, 2057 Cornell Rd., Cleveland, O., plans the construction of a 2 story, 50x100 ft. laboratory. A. B. Loomis, 10014 Burton Ave., Cleveland, is architect. $40,000.

Laboratory—State of California, G. B. McDougall, Archt., Public Works Bldg., Sacramento, is having plans prepared for an addition to its laboratory on 34th and Y Sts., to be used by State Highway Department. $25,000.

Laboratory—Trinity College, 115 Vernon St., Hartford, Conn., is having plans prepared by McKim, Mead & White, 101 Park Ave., New York, N. Y., for the construction of a chemical laboratory. First unit to be constructed now will cost $150,000; completed project, $450,000.

Research Laboratory — Union Carbide Co., Niagara Falls, N. Y., plans the construction of a 2 story, 95x173 ft. research laboratory building. $200,000.

Oil Refinery—Burlington Oil Refiners, Ltd., A. Woodburn, Engr., 1210 Pigott Bldg., Hamilton, Ont., contemplates construction and equipping of a cracking unit at its refinery. Prices and information are wanted on twenty 200 to 2,000 gal. capacity tanks, 3 heat exchangers, condensers, boilers, pumps, valves, service station equipment and Wayne or similar pumps.

Oil Refinery—Raritan Petroleum Corporation, c/o Louis H. Bean, 60 East 42nd St., New York, N. Y., plans to alter and remodel its refinery at Greensands, near New Brunswick, N. J. $28,000.

Patent Medicine Plant—Parmint Ltd., L. A. Miles, Engr., Fort Erie, Ont., plans to establish a plant for the manufacture of patent medicines, drugs, chemicals and compounds. $35,000.

Paper Plant—Crown Willamette Paper Co., 2945 East 12th St., Los Angeles, Calif., plans the construction of a 1 story, 150x200 ft. addition to its plant. $28,500.

Powder Factory — Hercules Powder Co., Wilmington, Del., and 120 Broadway, New York, N. Y., plans to rebuild its factory recently damaged by an explosion.

Process Plant — New Process Co., John L. Blair, Mgr., Warren, Pa., contemplates the construction of a 3 story factory on Hickory St., to replace the one destroyed by fire with a loss of $400,000. Bley & Lyman, c/o Owners, Archts.

Soap Factory—Iowa Soap Co., Burlington, Ia., plans to alter and enlarge plant of former Dobbins Soap Works at Camden, N. J., for its own use. New equipment will be installed. $50,000.

Warehouse — American Oil Co., American Bldg., Baltimore, Md., is having plans prepared for a 3 story, 100x150 ft. warehouse at its refinery on Curtis Bay. J. J. O'Connell, c/o Owner, Engr.

CONTRACTS AWARDED

Chemical Building—Earl Tyler, c/o Dwight Seabury Co., Archt., 12 East Ave., Pawtucket, R. I., has awarded the contract for a 2 story addition to chemical building on Lafayette St., to Herbert I. Mathewson, 30 High St., Pawtucket.

Distillery — Kroghman Distilling Co., Tell City, Ind., awarded contract for 3 story distillery to J. D. Jennings, 443 Garden St., Louisville, Ky. $100,000.

Distillery—St. Lawrence Distilling Co., J. P. Dunham, 2735 North Murray Ave., Milwaukee, Wis., awarded contract for distillery to Byrne Bros., 3100 West Burleigh St., Milwaukee.

Distillery—James Walsh & Co., Lawrenceburg, Ind., awarded contract for distillery to Hillsmith & Co., 108 East 3rd St., Dayton, O. $500,000.

Laboratory — Krebs Pigment & Color Co., 2001 Bonhill Ave., Baltimore, Md., awarded contract for laboratory and office building to Austin Co., Broad St. Sta. Bldg., Philadelphia, Pa.; 2 story addition to storage and change house and 1 story addition to Building No. 10, to Carl W. Schmidt, Munsey Bldg., Baltimore, Md. $65,000.

Match Factory — Canada Match Co., Ltd., Tracy St., Hull, Que., awarded contract for addition to factory to Brunet & Son, Hull. $25,000.

Refinery—Big Goose Refining Co., Sheridan, Wyo., awarded contract for crude oil plant to A. T. Croner, Sheridan.

Refinery—Gulf Refining Co., 30th and Penrose Aves., Philadelphia, Pa., awarded contract for additions and alterations to refinery to Lummus Co., 50 Church St., New York, N. Y. $1,000,000.

Refinery — United Refining Co., H. Eaton, Gen. Mgr., P. O. Box 780, Warren, Pa., awarded contract for 116 ft. fractioning tower to Struthers-Wells-Titusville Corp., Warren; replacing all wooden roofs on tanks and buildings with metal, to Hammond Iron Works, Warren, Pa. $75,000.

Solvents Recovery Building—Beveridge-Marvellum Co., 28 Appleton St., Holyoke, Mass., awarded contract for 3 story solvents recovery building, to P. J. Kennedy & Co., Inc., 326 Appleton St., Holyoke.

Stabilizing Unit—Shell Oil Co., Shell Oil Bldg., San Francisco, Calif., awarded contract for pressure distillate stabilizing unit at plant at Martinez, Calif., to Alco Products Co., Rialto Bldg., San Francisco.

Sulphur Factory—S. F. Sulphur Co., 9th and Heinz Sts., Berkeley, Calif., plans to construct a 1 story sulphur factory by day labor.

Sulphite Mill—E. B. Eddy Co., Ltd., Bridge St., Hull, Que., awarded contract for altering sulphite mill to Foundation Co. of Canada, Ltd., 1538 Sherbrooke St., Montreal.

Warehouse — Pittsburgh Plate Glass Co., Grant Bldg., Rochester, N. Y., awarded contract for warehouse to George Kirscher & Sons Co., 1384 Clifford Ave., Rochester. $35,000.

CHEMICAL LIME

Year	Production Tons	Imports Tons	Exports Tons	Average Price Ton*
1923	1,704,159	25,407	11,789	$9.18
1927	1,943,199	19,567	15,478	7.94
1929	2,290,612	21,501	17,334	7.33
1931	1,463,217	21,700	11,924	6.71
1932	1,070,000	16,650	3,579	6.33
1933	.....	10,505	3,.09	....

*Bulk, f.o.b. mine.

Uses: Chemicals, metallurgy, refractories, paper, water purification, glass, leather.

Producers: Alabama—Cheney Lime Co., Keystone Lime Wks., Muscle Shoals White Lime Co., Superior Lime & Hydrate Co. Arizona—Grand Canyon Lime & Cem. Co., New Process Lime Co., Paul Lime Co., Paul, Sheffield & Paul. Arkansas—Arkansas Lime & St. Co., Batesville White Lime Co., Ozark White Lime Co. California—Calif. Portland Cem. Co., Henry Cowell Lime & Cem. Co., U. S. Lime Products Corp. Colorado—Crystal Lime Co., Farmers Supply Co., Pueblo Lime Co., Western Lime Co. Idaho—Washington Brick, Lime & Sewer Pipe Co. Illinois—Black White Lime Co., Marblehead Lime Co., Menke Stone & Lime Co., U. S. Gypsum Co. Indiana—Hoosier Lime Co., Ind. Limestone Co., Lehigh Lime Co., Logansport Stone & Lime Co., Louisville Cem. Co., Salem Lime & St. Co. Kentucky—Rockcastle Cem. & Lime Co. Maine—Rockland-Rockport Lime Corp. Maryland—O. J. Keller Lime Co. Massachusetts—Berkshire Hills Co., Farnam-Cheshire Lime Co., Hoosac Valley Lime Co., Lee Lime Corp., N. E. Lime Co. Michigan—Antrim Lime Co., Campbell Stone Co., Inland Lime & St. Co., Limestone Products Co., Northern Lime & St. Co. Minnesota—Cutler-Magner Co., Fowler & Pay. Missouri—Arrowhead Mfg. Co., Ash Grove Lime & Port. Cem. Co., Bluff City Lime & St. Co., Centaur Lime Co., Glencoe Lime & Cem. Co., Missouri Lime & Mining Co., Peerless White Lime Co., Pierce City Lime Co., Ste. Genevieve Lime & Quarry Co., Western Lime Wks. Montana—Anaconda Mining Co., Elliston Lime Co. New Mexico—Canyon Lime Co. New York—Chazy Marble Lime Co., H. L. Devoe, Finch, Pruyn & Co., F. W. Wait Lime Co. North Carolina—B. & C. Lime & St. Co. Ohio—Carter N. Abel, Inc., Basic Products Co., Herzog Lime & St. Co., John W. Jenkins & Son, Kelley Island Lime & Trans. Co., Marble Cliff Quarries Co., Moores Lime Co., Ohio Hydrate & Supply Co., John D. Owens & Co., Scioto Lime & St. Co. Pennsylvania—American Lime & St. Co., J. E. Baker Co., Bonnymead Farms, Chemical Lime Co., Centre County Lime Co., G. & W. H. Corson, John Ebling, Everett-Saxton, S. J. Lightner, H. E. Millard, National Mortar & Supply Co., I. W. Peifer, Reinhard Lime Wks., Steacy & Wilton Co., Thomasville Stone & Lime Co., Valley View Lime Co., Thomas A. Wagner, Warner Co., Whiterock Quarries. South Dakota—Homestake Mining Co. Tennessee—Jesse Allen Lime Co., Curtin Lime Co., Gager Lime Mfg. Co., Oliver King Sand & Lime Co., Knoxville Sand & Lime Co., Southern States Lime Corp., Tennessee Cem. & Lime Co., Williams Lime Mfg. Co. Texas—Atlas Lime Co., Dittlinger Lime Co., El Paso Bldg. Material Co., Rock Round White Lime Co., Austin White Lime Co. Utah—Chief Cons. Mining Co., Langton Lime & Cem. Co., Utah Lime & St. Co. Vermont—Brandon Lime & Marble Co., Champlain Valley Lime Co., Fonda Lime Kilns, Green Mountain Lime Corp., Leicester Lime Corp., Swanton Lime Wks., Vermarco Lime Co. Virginia—Corson Lime Co., E. Dillon's Sons, Eagle Rock Lime Co., Five Oaks Lime & St. Co., M. J. Grove Lime Co., Kimbalton Lime Co., Limeton Lime Co., Moore Lime Co., New River Lime Co., Peery Lime Co., Powhatan Lime Co., Rockdale-Corson Lime Co., Strasburg Lime Co., Toms Brook Lime & St. Co. Washington—Idaho Lime Co., Orcas Lime Co., Roche Harbor Lime & Cem. Co. West Virginia—Blair Limestone Co., North American Cem. Corp., Washington Bldg. Lime Co. Wisconsin—Allwood Lime Co., Rockwell Lime Co., Sheboygan Lime Wks., Valders Lime & St. Co.

Additions and Corrections

On editorial supplement to January number and on page 168 of March number, add the following:

Naphthalene
Manufacturer: Reilly Tar & Chemical Corp., Indianapolis.

Carbon Dioxide
Manufacturer: Pennsylvania Sugar Co., Philadelphia.

CASEIN

Year	Production Lb.	Imports Lb.	Exports Lb.	Average Price Lb.
1923	21,371,176	26,489,992	.....	19c.
1927	23,516,481	24,209,504	.....	17.25c.
1929	57,826,167	27,583,339	.....	15.5c.
1931	40,804,599	3,503,249	.....	7.1c.
1932	24,428,000	1,201,014	.....	6.33c.
1933	.....	8,141,598	.....	10.55c.

Grades: U.S.P., technical.

Uses: Coated paper, plywood veneers, waterproof paints, wall paper, spray insecticides, casein plastics, cements, diabetic foods.

Manufacturers: Following increase in import duty to 5½c. per lb. in 1930, number of plants producing casein increased to 316. The number has since declined and many operate only intermittently. Principal producers include: California—California Milk Products Co., Gustine; Golden State Milk Products Co., San Francisco; Western Condensing Co., Eureka; United Creamery Assn., Arcata. Illinois—National Casein Co., Chicago. Massachusetts—H. P. Hood & Son, Boston; Whiting Milk Co., Boston. Michigan—Digestive Ferment Co., Detroit. Minnesota—Land O'Lakes Creameries, Inc., Minneapolis; Twin City Milk Producers Assn., St. Paul. Missouri—St. Louis Dairy Co., St. Louis. New York—The Borden Co., New York City; Casein Mfg. Co., New York City; Dairymens League Co-operative Assn., New York City; National Dairy Products Co., New York City. Wisconsin—H. C. Christians Co., Johnsons Creek; Galloway-West Co., Fond du Lac.

DEAD OR CREOSOTE OIL

Year	Production Gal.	Imports Gal.	Exports Gal.	Average Price Gal. f.o.b. works
1923	38,637,000	64,200,000	.....	11c.
1927	76,395,325	95,915,221	.....	12.9c.
1929	127,749,844	79,300,575	.....	12.6c.
1931	105,917,000	36,384,900	1,872,545	10.1c.
1932	.....	29,299,830	113,823	9.5c.
1933	.....	18,587,894	136,774	9.5c.

Uses: Wood preservative, lamp black, disinfectant, ore flotation.

Manufacturers: American Tar Products Co., Pittsburgh; Atlantic Creosoting Co., Norfolk, Va.; Baird & McGuire, Inc., Holbrook, Mass.; The Barrett Co., New York City; J. E. Berkheimer Mfg. Co., Tacoma, Wash.; William Cooper & Nephews, Chicago; Coopers Creek Chem. Co., West Conshohocken, Pa.; Crowley Tar Products, New York City; Inland Tar Co., Chicago; Jennison-Wright Co., Toledo; Kentucky Color & Chem. Co., Louisville; Koppers Products Co., Pittsburgh; Neville Co., Pittsburgh; Reilly Tar & Chem. Corp., Indianapolis; Robinson, Butler, Hemingway & Co., Bound Brook, N. J.; Sherwin-Williams Co., Chicago; Tar Products Corp., Providence; Tennessee-Eastman Corp., Kingsport; U.G.I. Contracting Co., Phila.; Wailes Dove-Hermiston Corp., Westfield, N. J.

IRON CHLORIDE

Year	Production Lb.	Imports Lb.	Exports Lb.	Average Price Lb.
1923	2,104,000	64,097	.....	8.30c.
1927	2,985,663	631,188	.....	7.80c.
1929	5,941,289	842,458	.....	6.80c.
1931	7,764,867	812,956	.....	5.00c.
1932	.....	365,084	.....	4.75c.
1933	.....	.....	.....	4.75c.

Uses: Mordant in dyeing, metallurgy, medicine, photogravure, iron salts, organic synthesis, deodorant.

Manufacturers: Chas. Cooper & Co., Newark, N. J.; Dow Chemical Co., Midland, Mich.; E. I. du Pont de Nemours & Co., Wilmington; Grasselli Chemical Co., Cleveland; Gt. Western Chemical Co., San Francisco; Hooker Electrochemical Co., Niagara Falls; Monsanto Chemical Co., St. Louis; Pennsylvania Salt Mfg. Co., Phila.

New Data on Chemical Raw Materials for Process Industries

Continued from *Chem. & Met,* March, 1934, page 168.